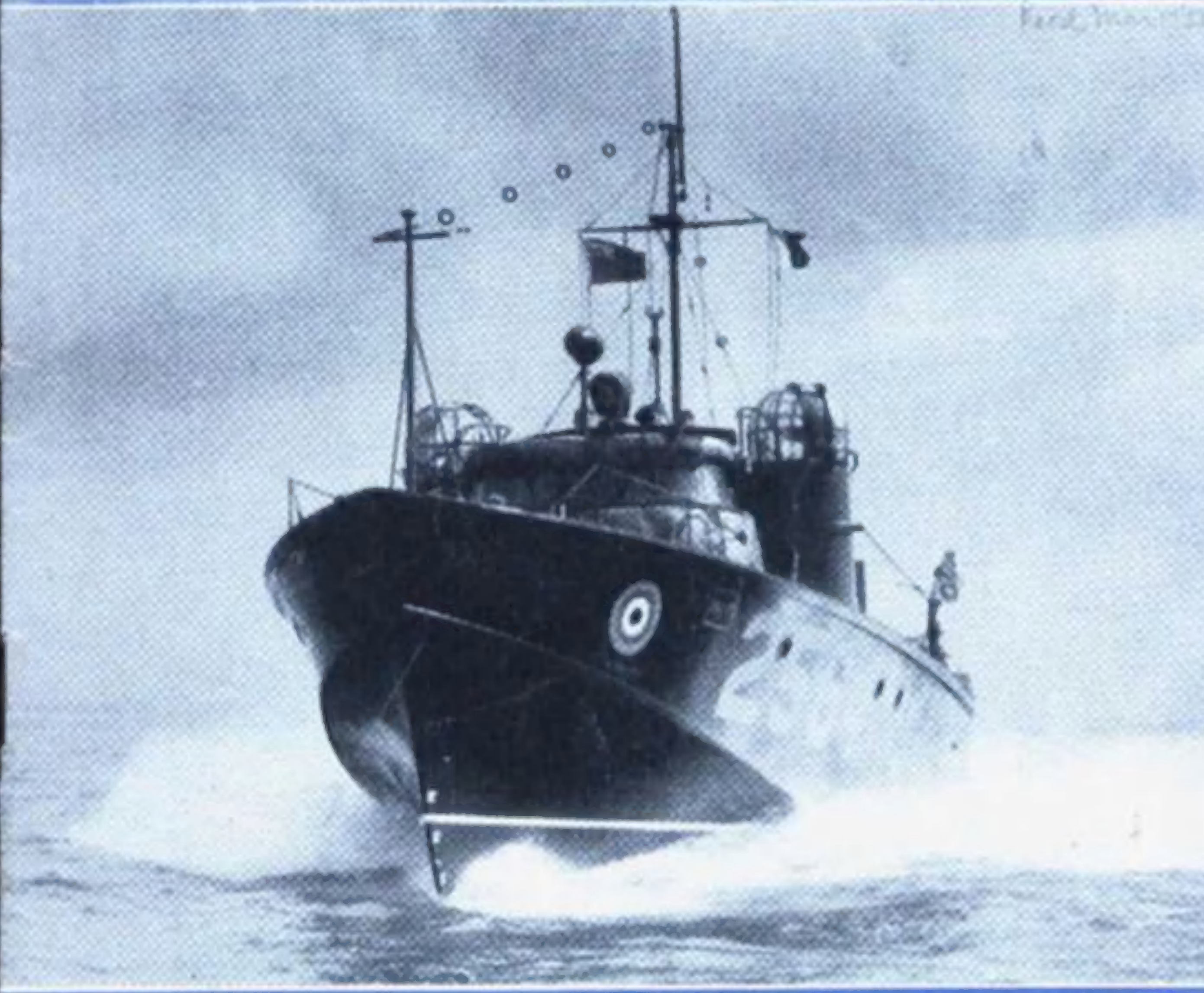
THE MODEL ENGINEER



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THE MODEL ENGINEER

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Our Cover Picture

Air Sea Rescue Launch, 2564, was built by Vosper Limited, who kindly supplied the photograph, which is their copyright. These craft, and also the M.T.B.s are very popular as prototypes for models, as they look both fast and powerful, and when powered by the popular diesel engine, several suitable sizes of which are available commercially, they travel at a good speed and throw up an impressive bow wave and wake. Moreover, the hard chine hull is easy to build, the materials are comparatively easy to obtain, and the superstructure is of a very convenient shape for the installation of the engine.

Detailed drawings of the Vosper M.T.B., prepared by W. J. Hughes, are available from our Plans Dept. Reference No. P.B. 11. 2 sheets price 10s. 6d.

At ½ in. scale, the hull dimensions are 36¼ in. long, by 9¾ in. beam, and 2¾ in. draught, which gives ample space and displacement for the fitting of radio control.

SMOKE RINGS

" Cutty Sark "

IN THESE somewhat callous days, when so much that is worth preserving is being ruthlessly scrapped, due to official disinclination to sanction the expenditure of public funds, there is cause for much satisfaction when energetic public action is taken to prevent an irreparable loss. The most recent instance of such public action is to be found in the formation of the " Cutty Sark " Preservation Society.

Cutty Sark is the only survivor of a grand company of clipper ships which, in the 1870s, achieved, not only world-wide fame, but the highwater-mark of sailing-ship performance, by their exploits in the China tea and Australian wool trades. Many were the races held between rival clippers, causing great excitement at the time, and *Cutty Sark* was often a winner. In fact, enthusiasts are divided as to whether this glorious ship was not the best of them all.

However, about a year ago, a proposal was made that *Cutty Sark* should be rescued from the fate that overtook her contemporaries, restored to her original condition, acquired and preserved as a national monument. There was widespread approval of this idea, but the cost of putting it into effect was found to be prohibitive, so far as official use of public funds is concerned. The next step was the formation of the " Cutty Sark " Preservation Society, through which subscriptions and donations, already being received, will be applied to acquiring, housing, restoring and preserving *Cutty Sark*.

The Patron of the society is H.R.H. the Duke of Edinburgh; anyone interested in its work should write to the " Cutty Sark " Preservation Society, Palmerston House, 51, Bishopsgate, London, E.C.2.

Locomotive *v.* Elephant

WHEN GEORGE STEPHENSON was asked what would happen if a locomotive should collide with a cow, he is reputed to have replied that it would be " bad for the coo." Mr. J. D. Allen, of Northern Rhodesia, has sent us a newspaper cutting which recounts an incident that is strongly reminiscent of the " Geordie " story, except that the locomotive collided with an elephant. It seems that such collisions occur occasionally in Africa, and it is usually the elephant that comes off second best.

The particular incident referred to in Mr. Allen's cutting took place in the early hours of a recent Saturday morning, when the driver of a passenger train was unable to avoid colliding with a bull elephant while running near Inyantue. Damage to the engine, a Garrett, included: a broken jack (the second one was badly bent), a severely bent buffer-beam, a damaged vacuum brake standpipe, two broken sections of valve-gear, a broken vacuum brake cylinder and two broken sets of steps. Damage to the elephant is not stated; but it must have been considerable if he came off second best!

For Newcomers in Toronto

WE WERE pleased to receive a letter from Mr. Chas. Barker, secretary of the Toronto Society of Model Engineers, who tells us that, of a number of people who have recently moved from England to Canada, some have joined the Toronto society.

The Toronto S.M.E. is a progressive club possessing a locomotive track and a pond for power boats; it holds a meeting every three weeks at the Botany Building of the University of Toronto, and dates for future meetings are: March 13th, April 10th and 24th, and May 15th.

If any reader resident, or about to become resident in Toronto, is interested in the society's activities, he is invited to contact Mr. Chas. Barker at 122, Chudleigh Avenue, Toronto.

HISTORIC OSCILLATING ENGINES

By G. B. Round

SINCE 1919, when I first became acquainted with THE MODEL ENGINEER, quite a number of articles have appeared in its columns on the oscillating steam engine, but relatively few references to the form in which the cylinder is pivoted at the top, or the pendulous type, as it is more commonly known.

Quite recently, I acquired from the second-hand department of a large bookseller, a book on the *High-pressure Steam Engine* by Dr. Ernst Alban, of Plau, Saxony, translated into English by William Pole, F.R.A.S. (the author of the book on *Cornish Engines*) and published by John Weale, 59, High Holborn, London, in 1848.

Upon reading this very interesting volume, it was discovered that it was almost entirely devoted to the pendulous type of oscillating steam engines, of comparatively small powers, together with their boilers, as erected by Dr. Alban about the year 1840, being the form of engine which he considered best adapted to the use of high-pressure steam. Included in the book are a number of excellent scale drawings showing the details and construction of these engines. Realising that many readers of THE MODEL ENGINEER are interested in the older types of steam engine, the following description and drawings have been taken from this book.

Figs. 1 and 2 show the front and side elevations respectively of an engine of 10 h.p., and the elaborate ornamentation of Doric design will at once be apparent. The dimensions of the cylinder are 8 in. bore, with a stroke of 2 ft.; diameter of piston-rod, 2 in.; steam ports, 3 in. long by $\frac{3}{8}$ in. wide; flywheel, 10 ft. diameter with four arms of cross or X section, and making 50 revolutions per minute. The working pressure is about 60 lb. per sq. in.

The engine is surmounted by a governor acting on a throttle valve, and is fitted with a two-speed pulley for a flat belt to allow of running the engine at an alternative speed. In passing, only four arms are considered sufficient for flywheels up to 10 ft. in diameter, and above that size, six arms.

General cross sections of the engine are shown in Figs. 3 and 4, and these indicate the construction

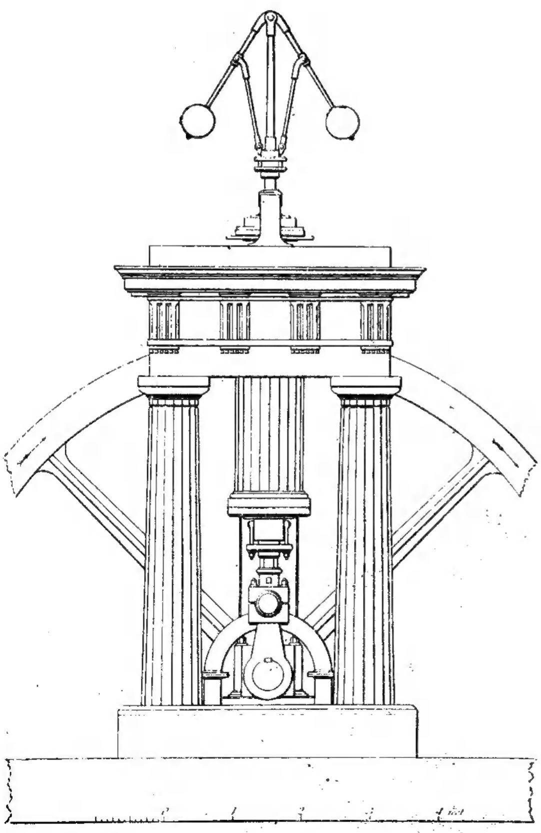


Fig. 1. *Front elevation of* 10 *h.p. oscillating engine*

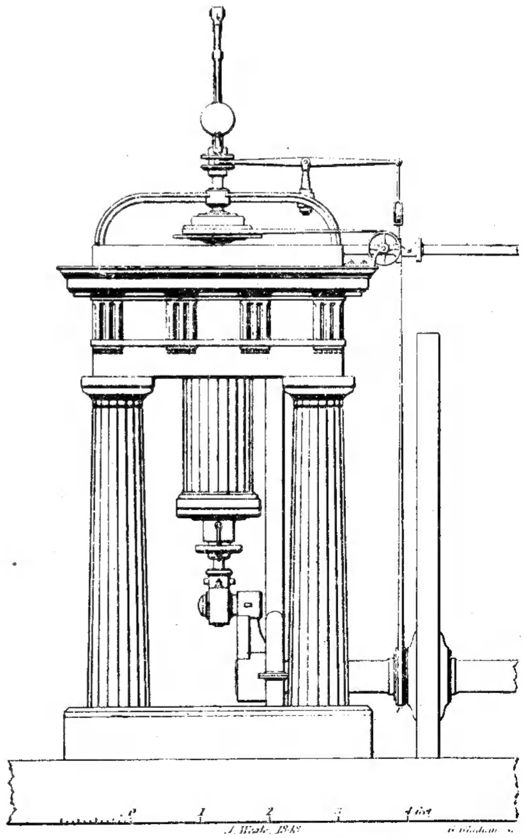


Fig. 2. *Side elevation of* 10 *h.p. engine*

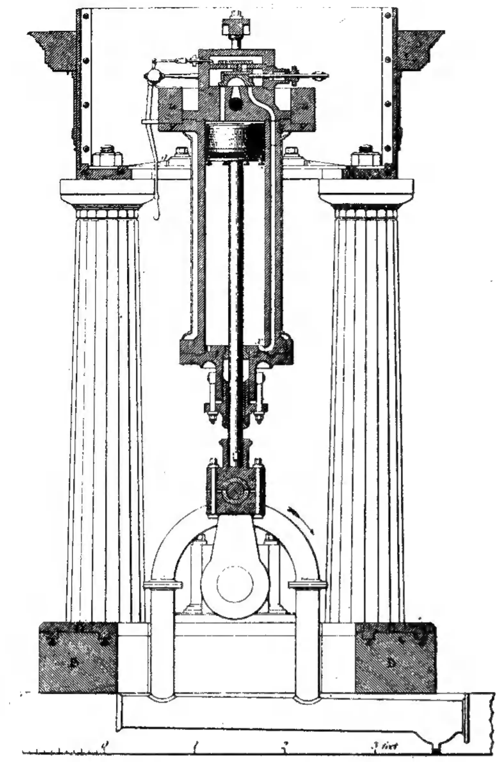


Fig. 3. Sectional front elevation

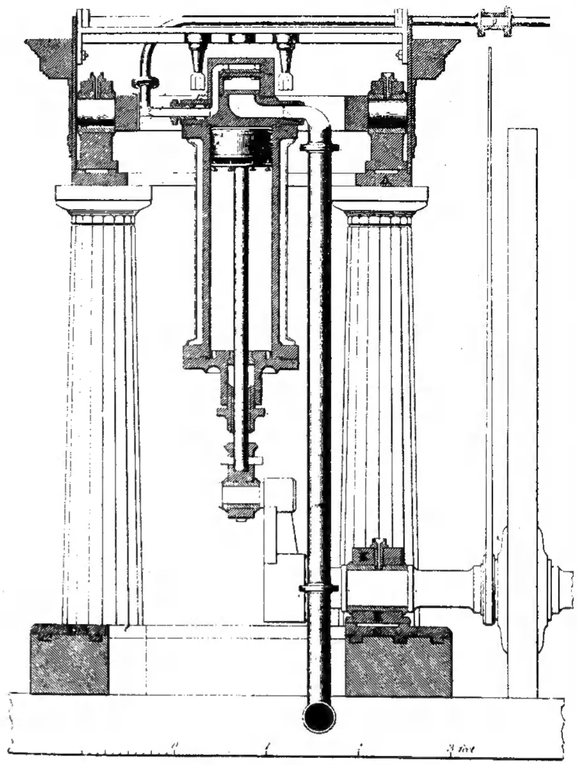


Fig. 4. Sectional side elevation

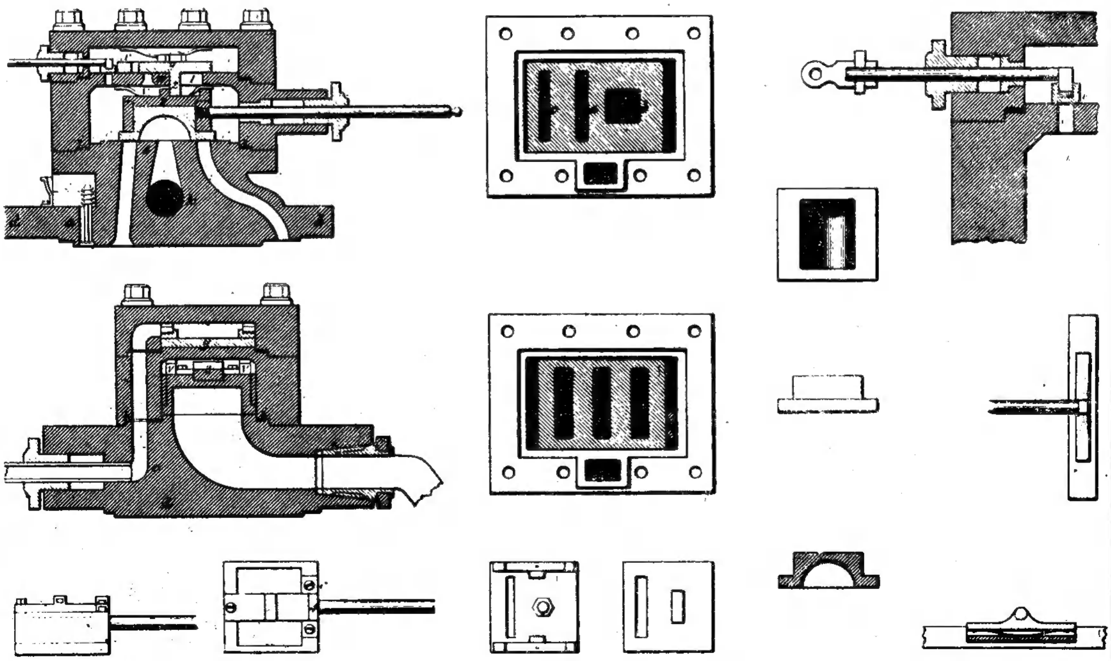


Fig. 7. Details of trunnions and slide-valves

of the engine in greater detail. The framing consists of a top plate, 7 in. wide, and a bottom plate, 10 in. wide, both plates being $1\frac{1}{4}$ in. thick, separated by four hollow fluted columns of a circular section, with separate square top finials ; the whole being held together by four strong bolts passing through the columns, tying the top and bottom plates together, the columns acting as distance pieces. The bottom plate stands on a plinth or sill-frame of oak, registered by projections or ribs cast on the underside of the bottom plate, and the whole bedded on a foundation of masonry. The casing. The bottom cover is of normal design, except for the method of attaching the piston-rod gland by eye-bolts instead of the usual studs ; the upper cover, attached to the cylinder by six or eight bolts, forms the port-face for the main slide valve, an arrangement which necessitates the port for the lower end of cylinder being excessively long, as it has to travel the full length of the cylinder. Bolted to the top cover is the valve chest containing a main slide valve and an auxiliary expansion valve, worked by the main valve, to give a steam cut-off at one-third of the stroke.

The steam from the boiler is led up through a passage in the side of the valve chest into the upper valve box, and then through the centre slot or port in the port-face when this is uncovered by the expansion valve, and also through the left-hand port when this is uncovered by means of the hand lever. The square hole to the right of the centre steam port is for the projection on the underside of the expansion valve to work in. The main slide valve and its port-face are of normal construction and is operated by means of links on either side of the cylinder, pivoted on brackets fixed to the underside

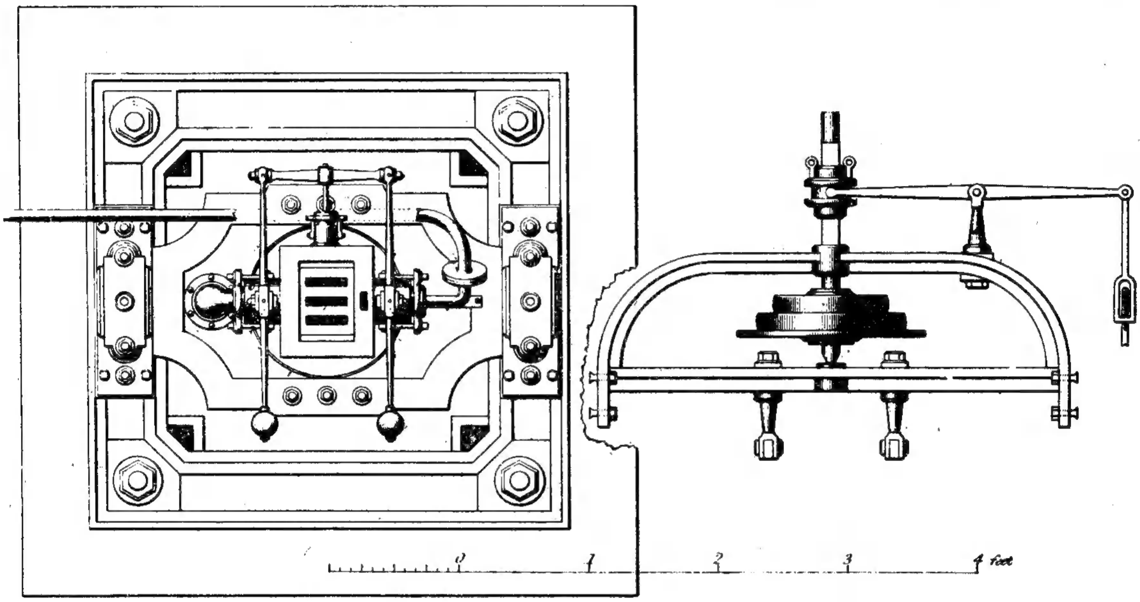


Fig. 5. Details of entablature

crank is a casting of the single web overhung pattern, and the crank-shaft is carried in one bearing bolted to the bottom plate, with a separate outboard bearing for the outer end, with the flywheel in between.

The cylinder has two ears, 8 in. wide by 2 in. thick, cast on the top flange to enable it to be attached to the trunnion frame. This frame is an essential feature of the design, and consists of a rectangle of substantial thickness and about 5 in. deep, with the corners internally curved in plan, pivoting in plummer blocks bolted to the top plate of the framing, as shown in Fig. 5, which also shows the plan view of top plate, port-face of cylinder, and links for operating the slide valve.

Lagging is fitted to the cylinder and is covered by a fluted metal

This design is, in fact, two valve boxes superimposed one upon the other, with the expansion valve operated by a projection on the underside of valve, passing down through a slot in the expansion valve face, and moved by two projections on the back of the main slide valve. These latter projections are so spaced as to allow for the intermittent movement of the expansion valve, and its shorter travel than the main valve. Fig. 6 shows the relative positions of the two valves for various angles of the crank, and the arrangement of the slide valves is shown in greater detail in Fig. 7. This also shows the auxiliary valve operated by a hand lever to supersede the action of the expansion valve when extra power is required, or when starting up the engine.

of the cross-bridge on top of the entablature which carries the governor. These links are extended beyond the pivots to carry balance weights in order to balance the valve operating mechanism. Glands on each side of the valve chest, on the centre line of the trunnion bearings, allow for the steam and exhaust pipes passing into the valve chest without being affected by the motion of the cylinder, the steam pipe being prevented from blowing out of its gland by the use of a wooden packing block, fitted between the steam pipe and the trunnion frame. The whole object of this arrangement is to eliminate the necessity for the steam and exhaust pipes to pass through the trunnion bearings, and thus avoid the high temperatures to which these bearings would otherwise be sub-

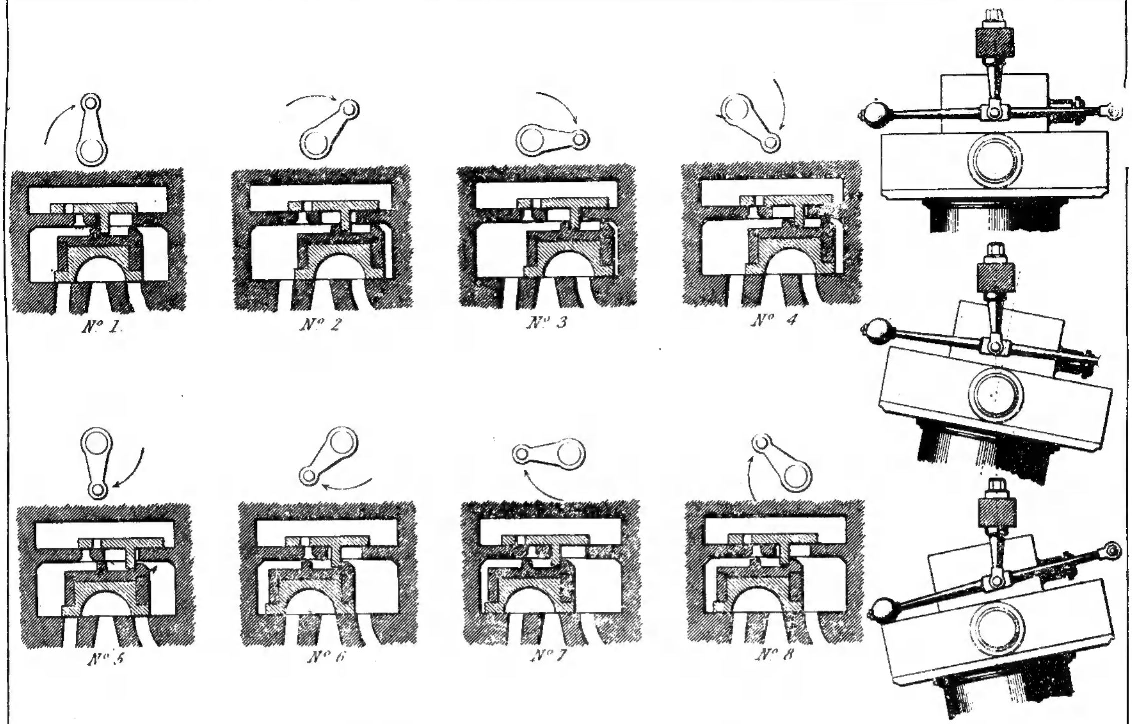


Fig. 6. Relative positions of crank and slide-valves

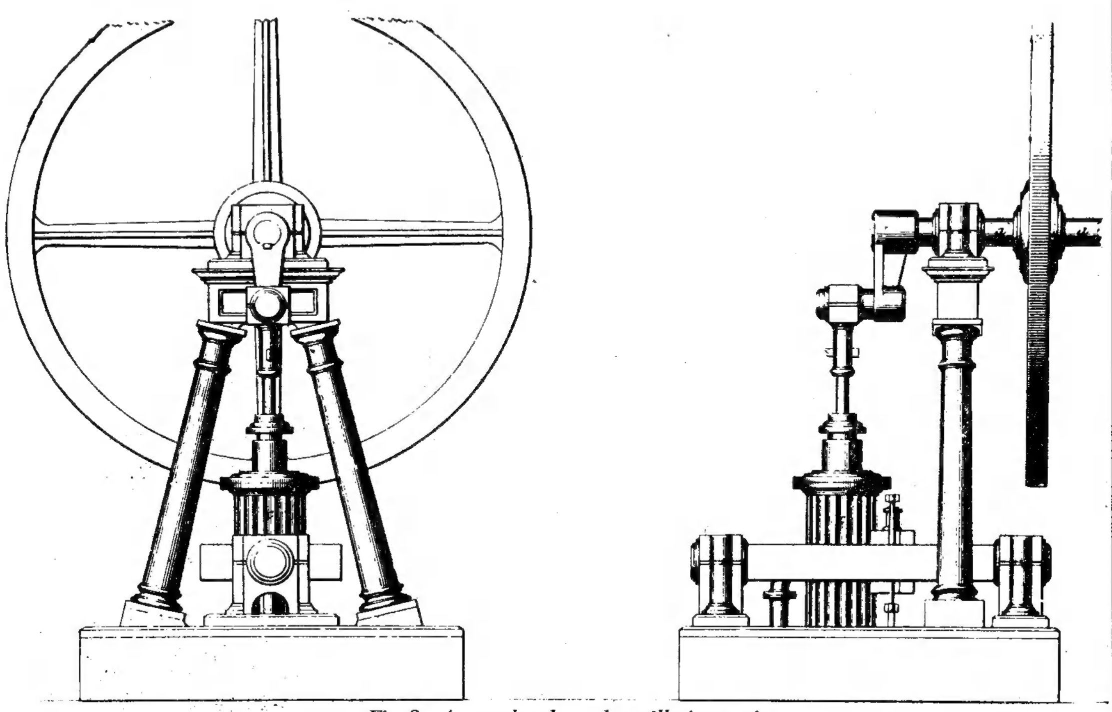


Fig. 8. An overhead-crank oscillating engine

jected. The exhaust pipe is taken vertically downwards, and probably for the sake of appearance, it is looped each side of the crankshaft, and led into a simple form of condenser, which, however, produces no effective vacuum, and is little more than a drain for the water contained in the exhaust steam.

The whole of the top of the cylinder, and the valve operating mechanism, is contained within the entablature surmounting the top plate. This is a box, built up of cast-iron side plates bolted together, and to the top plate. It is ornamented with Doric triglyphs of cast-iron, riveted on to the side plates. A cornice of wood (oak), is slipped over from above, and the top of the cornice is protected by a wrought-iron plate, in order to prevent injury to the edges when a ladder is placed against it for gaining access to the cylinder top for oiling and adjustment, etc.'

Referring back to Fig. 5, the cross-bridge bolted to the sides of the entablature, and carrying the governor and brackets for the links operating the slide valve, is shown in greater detail, although the arms and balls of the governor are omitted from this view.

A more normal type of oscillating engine with the crank overhead, carried by a pair of inclined columns, but embodying the principle of the trunnion frame for carrying the cylinder, is shown in Fig. 8. A unique application of the oscillating cylinder is shown in Fig. 9. Here the cylinder is placed on the top of a short vertical shaft, carried at the bottom in a footstep bearing, and at the top, just below the cylinder, by an ordinary plummer block. The cylinder swings in a horizontal plane driving a vertical crankshaft, carried in similar bearings to those under the cylinder, for giving motion to the stones of a flour mill. Due to the abnormal length (for an oscillating engine) of the piston-rod, it is possible to use an ordinary eccentric and rod, directly connected to the slide valve, as the lateral movement of the valve chest is not sufficient to affect seriously the valve travel or timing. The eccentric is driven by a return crank which has its crankpin in line with the main shaft. This engine, however, gives one the impression of being a truly fearsome affair when in action. As a prototype for a model of unusual appearance, any one of these three engines would prove interesting to the model-maker on the lookout for something different.

While not of the oscillating type, there is another little engine illustrated in this book on the *High-pressure Steam Engine* which is well deserving of mention. It is shown in Fig. 10, and is a small beam pumping engine, rated at only 2 or 3 h.p., erected by Dr. Alban to lift water at the Dobberan Turf Moor, somewhere around 1840. The cylinder is single-acting, with the underside of the piston constantly open to the rather crude form of condenser Dr. Alban applied to most of his engines.

A simple slide valve is fitted, as shown in the enlarged sections, and operated by tappets on a plug rod. To prevent the engine from making too long a stroke, either upwards or downwards, the primitive, although effective, arrangement of a catch rod, attached to the beam on the pump side, incorporating stops fixed to the rod, is made use of, to control the length of stroke. As the engine is so small, the piston and pump rods are attached to the beam by strong straps, probably of leather, and it

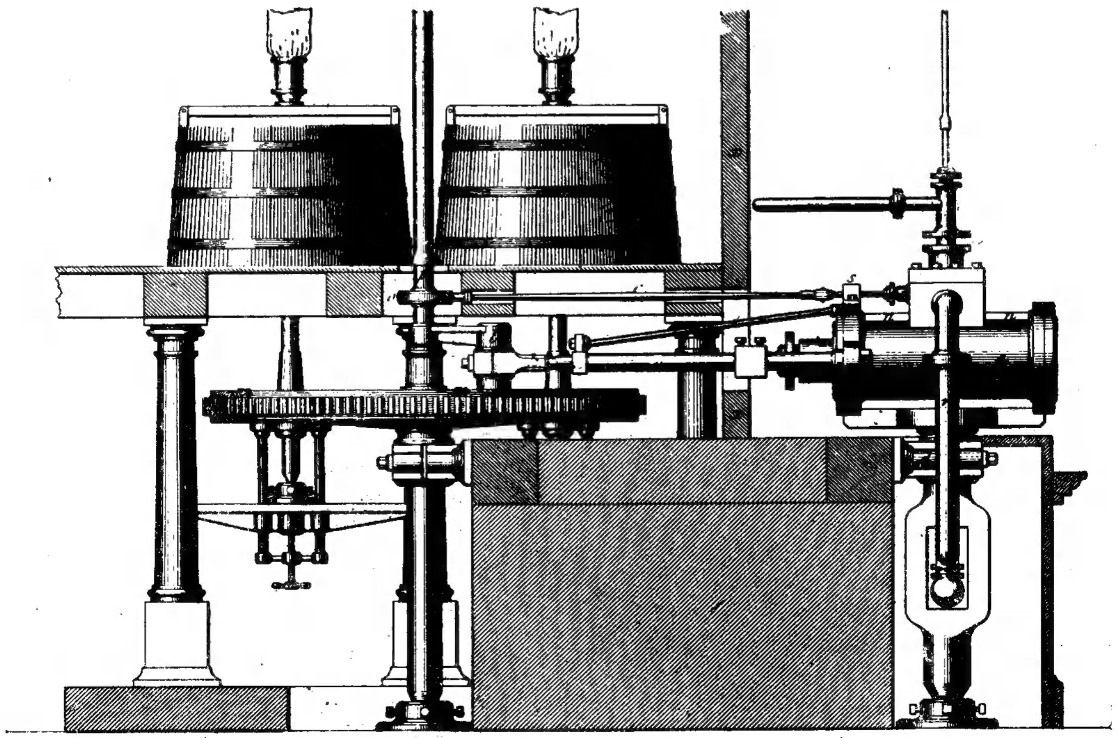


Fig. 9. A vertical-shaft oscillating engine

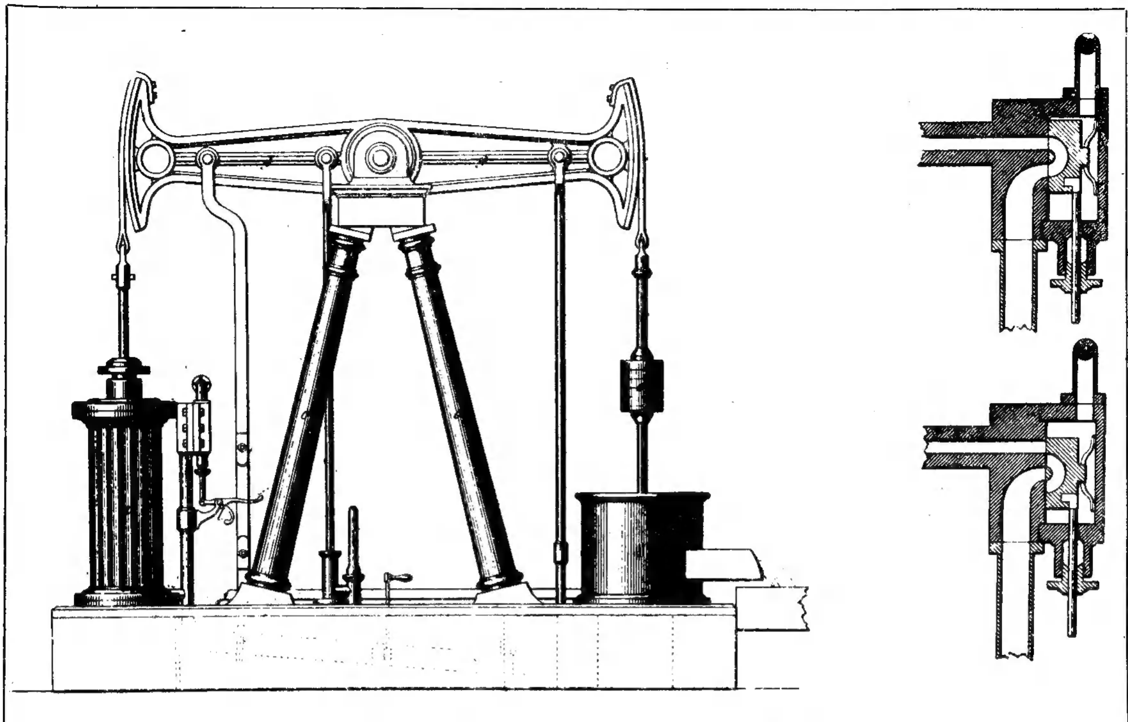


Fig. 10. A small single-acting beam pumping engine

will be seen that the form of beam is that originally used by Newcomen, using arch-heads at the ends to allow for the motion of the ends of the beam relative to the vertical movement of the piston and pump rods ; being used here in the form of a one-piece casting. Unfortunately there is no scale to this drawing, but a reference in the text to a 3 h.p. engine gives the size of the cylinder as 4½ in. in diameter, by 1 ft. stroke. This would seem to be the smallest beam pumping engine ever erected for serious work, it is certainly the smallest the writer has heard of, with the possible exception of the small power Cornish pumping engine in the Science Museum, Kensington.

This little engine would make an excellent prototype for an unusual, but relatively simple working model.

THE PRODUCTION OF WASHERS

REQUIRING a quantity of washers in 1/64-in. graphited "Hallite" type sheet jointing, some with ¼ in. dia. centre hole with a flange width of under $\frac{1}{16}$ in., and a further quantity ⅝ in. hole $\frac{3}{16}$ in. flange, with six accurately placed bolt holes, I spent several vexatious hours with dividers, punches, scissors, razor blades, etc., to very little effect.

Realising that a better procedure was indicated, plus some method, I eventually obtained an entirely accurate and satisfactory result.

Cut rectangular pieces of material with some extra, for wastage and spares ; these should be larger than the outside diameter of the washer required. Arrange these sandwiched between small rectangulars of thin plywood, these should have small holes drilled in each corner ; connect up with small bolts, and draw up the assembly as tight and solid as possible without unduly flexing the plywood. The centre hole can then be drilled as required, also any necessary bolt holes in the flanges can be drilled from a jig, template or one of the actual components to which the washers are to be fitted. Put a waste end of M.S. rod, about the outside dia. of the washers, in the three-jaw, turn a spigot on same to the inside dia. of the washers and to a length that will accommodate the assembly plus sufficient for a screw-thread, nut and washer to enable all to be compressed as solidly as possible on the spigot and against the shoulder.

Remove the four small bolts and turn down the assembly to the required outside dia.

The material, when compressed, will drill and turn cleanly.

This all sounds a lot to produce a few washers, but is actually not much trouble, and from experience I can guarantee perfectly formed washers that will fit neatly into their functional purpose, and not require any further trimming.—LEN BROWN

Silver-soldering light components

By S. W. Hugo, A.M.I.Mech.E.

MANY model makers, especially those interested in railway modelling in the smaller gauges where the ability to make clean strong joints is of importance, would take up silver-soldering if it were realised how easily mastered is the technique.

Silver-soldering or brazing is, of course, necessary on pressure-tight joints, and some model engineers may trace their reservations as to its use where this quality is not essential to heated activities with large blowlamps and piles of coke. To overcome prejudice, it should be realised that where pressure tightness is required, the mating sheets or plate must be relatively thick, requiring a large amount of heat to make a satisfactory joint. When joining thin sheets, however, the work can be accomplished with light blowpipes, without the need of a brazing hearth, or even moving from the bench or work-place.

The resulting joints will be clean and much stronger than soft-soldered work. Probably the greatest advantage lies in the actual manipulation. Once one joint has been made, the local heat applied by the blowpipe to an adjacent joint is not sufficient to free the first one. Alternatively, when a higher degree of skill has been acquired, it may be possible to assemble the work completely and braze it as a whole.

A large forced air/gas blowpipe and brazing hearth are desirable for heavy work, and in the hands of the skilled, such equipment can be used to braze quite small and intricate assemblies completely in one operation. For the silver-soldering of joints in light metal singly, or in a progressive manner analagous to welding, light blowpipes may be used, and many satisfactory types are available commercially. The writer has found some pleasure in making his own, and the design is presented in Fig. 1. In many cases, the drawing is dually dimensioned, and by working to the smaller and larger sizes in turn, it is possible to provide two sizes of pipe. It may be pointed out that the smaller is only suitable for joining material up to about 0.015 in. thick. Both pipes can be regulated, within their capacities, from a gentle flame to a hard noisy flame, yet possessing a rock-steady inner cone with a sharply defined tip. The formation and steadiness of the flame will depend entirely on the concentricity of the jet and nozzle, and the lack of play in the threaded portions. The jet and primary air-hole sizes are correct for average mains gas pressure, but if a hard flame cannot be obtained at maximum air admission, the jet may be peened in slightly or the air holes opened out. It is inadvisable to make the gas pipe nipple to suit domestic size tube, as the manipulation of the pipes becomes clumsy. Laboratory tubing should be used, at least for a few feet, when a conversion nipple to heavier tube may be inserted if desired. Avoid, however, very thin rubber tube, which kinks and cuts off the flame at inopportune moments. The handle was made by winding soft welding-rod around a mandrel of the same size as the outside diameter of the copper pipe. The wire may be safely fed through the hand, but the operation calls for a heavier lathe than that possessed by the average modelmaker. As there is little "spring" in the wire, the handle is a fair fit on the tube, and is sweated to it at both

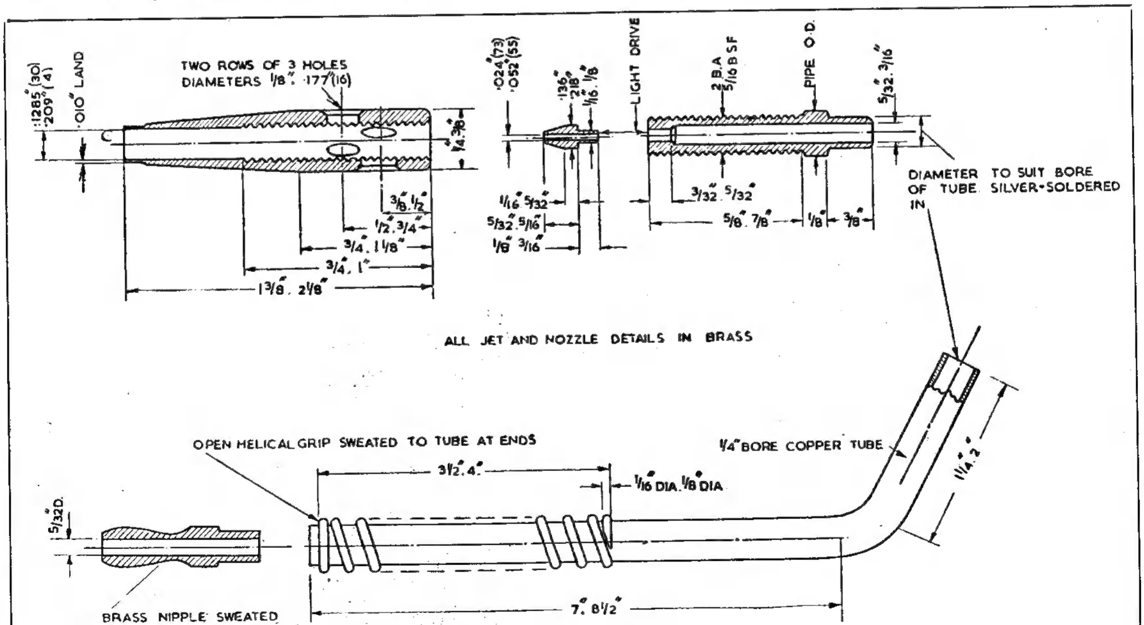


Fig. 1. Details of blowpipes

ends. A bakelite grip may be made if preferred.

The jet is a light drive fit into the screwed part of the nozzle assembly, which part is, in turn, silver-soldered into the head of the copper pipe. If, therefore, the flame should light back on to the jet and remain unnoticed, the increasing heat will not loosen the parts. Care should be taken to make these screwed parts with sufficient overlap that the primary air may be cut off completely during idle times, yet at maximum air admission there is sufficient length of engagement to prevent wobble of the nozzle.

Having made or acquired suitable blowpipes, certain additional equipment is necessary. A cone of jewellers' borax and a piece of smooth slate about 4 in. or 5 in. square are required, together with a jeweller's carbon block. This is a graphite block about 5 in. by 3 in. by $1\frac{1}{4}$ in. which serves as a refractory support for the work. Whilst one is essential, it is advisable to have up to half a dozen, such that three or four may be kept and used only to support work at right-angles. The others may be used for general purposes, and may even be carved out, using a pocket knife, in order to support work of special or fragile shape. The cost of such blocks is but a few pence each.

To complete the equipment, a roll of fine gauge soft iron wire is necessary, a supply of ladies' hair grips of the type shown in Fig. 2, and a quantity of $\frac{1}{16}$ in.-$\frac{1}{8}$ in. diameter split-pins of assorted lengths. It is also useful to make up small toolmaker's clamps in dural. One or two old pairs of pliers, for handling hot work, are useful and an artist's palette and fine camel hair brush complete the list. It is, of course, assumed that the necessary metal working tools are available. Should it be proposed to carry out the work on the table top, a sheet of 16-gauge steel about 2 ft. square, placed on top of newspaper packing, will adequately protect the surface.

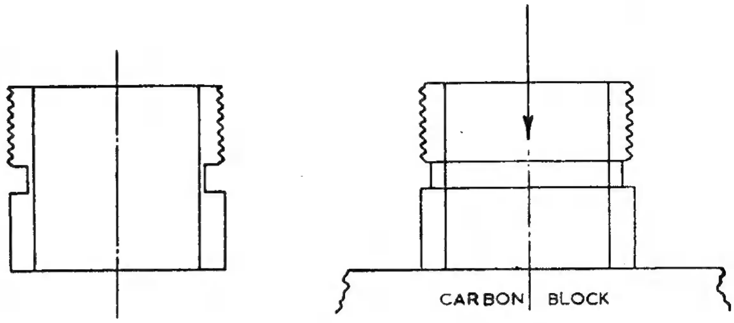


Fig. 4. Eye-piece ring and repair set-up

Materials

It is, of course, essential that the silver-solder used should have a lower melting point than that of the metals to be joined. Where the melting point of the metals is low, the choice of the solder must be made with care. Where it is required to join silver articles, not only must the solder fulfil the requirements, but must also comply with specifications relating to bullion if the articles are to be hall-marked and sold. It is assumed that the majority, however, will be only interested in the joining of brass, nickel-silver, etc., in which case ordinary silver-solder as purchased at a good ironmongers' will be found quite satisfactory. Every effort should be made to obtain this in thin strip, and if this be impossible locally it will be necessary to send away for it. For the sake of interest, certain approximate data is presented at this stage:

Silver Solders B.S.S. No. 206

Grade A. Silver, 61 per cent.; copper, 29 per cent.; zinc, 10 per cent.; Melt 690-735 deg. C.

Grade B. Silver 37 per cent.; copper, 37 per cent.; zinc, 20 per cent.; Melt 700-775 deg. C.

Melting Points

Copper, 1,080 deg. C.; brass, 890-1,000 deg. C.; nickel, 1,455 deg. C.; nickel-silver, 1,030 deg. C.; silver, 961 deg. C.; steel, 1,500 deg. C.

These temperatures are approximate, and depend, in the case of alloys, upon the proportion of alloying elements.

Procedure

The first and most important thing in any soldering operation, soft or hard, which will amply repay time spent, is to consider how to hold the parts securely in alignment during the operation. In addition, whatever clamping arrangements are used, they should not be such as to abstract heat from the joints. Therefore, do not attempt to solder work in bench vices, or

Fig. 2. The hairgrip

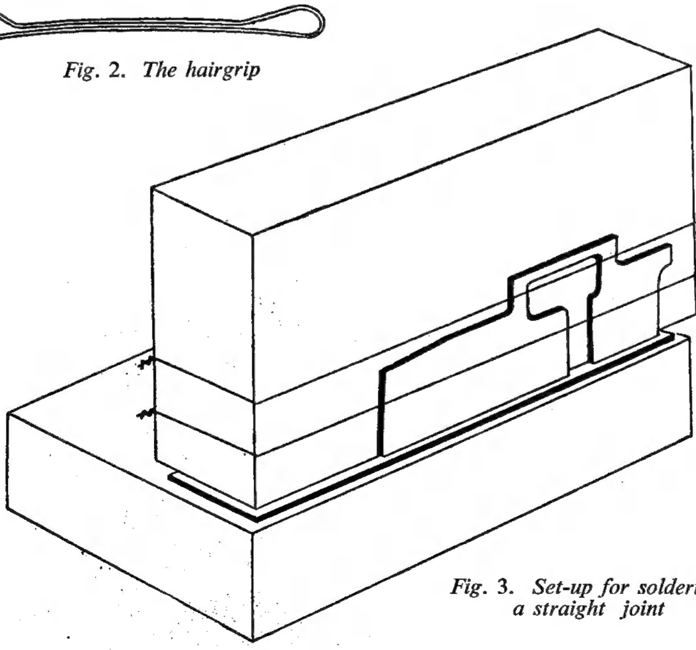
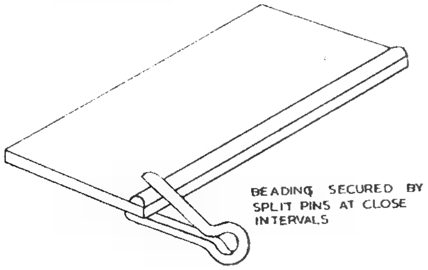


Fig. 3. Set-up for soldering a straight joint



Fig, 5

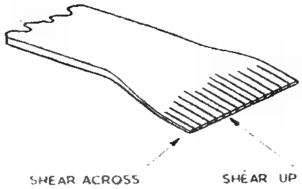


Fig. 6

whilst held by heavy steel toolmaker's clamps.

It is here that the jewellers' carbon blocks, iron wire, hairgrips, cotters, etc., are employed. Fig. 3 shows a method of holding one plate at right-angles to another, employing two jeweller's blocks and iron wire. Fig. 4, on the other hand, shows the type of job which can occasionally be handled without any fixings whatever. The first sketch shows a screwed brass ring, part of the eyepiece of a pair of binoculars. The undercut had been taken too deep in original manufacture, and operation of the eyepiece had broken the screwed portion off. In the second sketch, the existing screwed and plain portions had been cleaned up with a fine file and a new, and more solid undercut section turned up and silver-soldered in position, by directing the flame of the blowpipe downward in the direction of the arrow. The flame rebounding from the surface of the carbon block gave uniform heating of the circular joints. Including the making of the new ring, this repair took approximately one hour, considerably less than the time required to make a new part involving the cutting of a metric thread.

Fig. 5 shows a beading secured to a plate edge by means of cotters, thus ensuring a continuous metal to metal joint without gaps. Incidentally, jewellers' suppliers carry all sections of silver wire, which are quite cheap on a length basis, and are more easily handled than drawn brass or nickel-silver wires. The whole question of supporting and clamping the work is one of experience. The beginner is advised of one thing: never proceed with work, the fixings of which become unsatisfactory when the heat is applied, even if this means preparing the joints again.

After the method of fixing has been decided, the joints should be prepared by cleaning with fine emery or a brass wire brush, and dipped for a few seconds in dilute sulphuric acid. They should then be cleaned with a dry clean rag. The mating edges should be fluxed with paste made by dropping a little water on the slate, and rubbing the base of the borax cone around in it. A thin creamy consistency is required, and the camel hair brush is used to apply it thinly and evenly to the metal. The work is then set up in the manner decided upon. A quantity of borax paste is transferred to the artist's porcelain dish or palette and small snippings of solder cut into it. The method is shown in Fig. 6. The end of the solder is rolled or flattened, and cuts made with shears in order to "fringe" it. Further cuts across these will release small pieces of solder into the palette, whence they are transferred, well fluxed, to the edges of the joint by means of the camel hair brush. The thinness of the solder, the size of the snippets, and their spacing along the joint edge depend on the size of the material, and again can only be estimated by experience. The fluxed pieces of solder will adhere to the flux at the edges of the joint, and when the blowpipe is applied, heating the whole of the length of the joint uniformly, the solder will run into the joint cleanly, leaving no excess. Whilst a fillet may be made if required, the writer has found that this is best accomplished by running such fillet in soft solder with the copper bit.

After silver-soldering, the work should be cleaned by pickling in dilute sulphuric acid, cleaning well with water, drying, and finishing by mechanical means; needle file, brass wire brush, or emery paper, as the condition of the work and the finish required warrants.

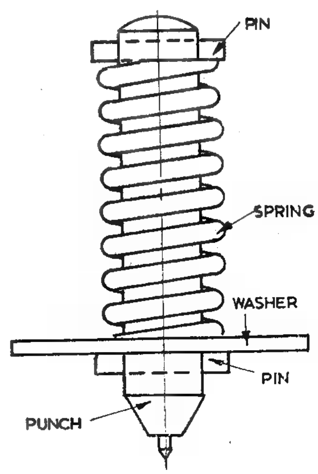
The general advantage in hard-soldered joints is that they will withstand an accidental knock which would fracture a soft-soldered joint, a very trying occurrence, especially after a model has been painted. Further, should it be necessary to fill cavities in the body of the model with molten lead to increase the weight, this may be done without risk to the joints. Finally, when the technique has been mastered, it will be found neater and swifter on many classes of work.

A home-made automatic punch

The illustration gives a clear idea of a simple automatic punch, made from scrap-material. The body consists of $\frac{3}{8}$-in. round machine-steel, with inserted point made from tool-steel, and hardened. The operation with this tool is extremely easy, necessitating only one hand, no hammer, nor any other auxiliary tool.

In operation, you put the point exactly upon the place where you will mark the centre (generally at the intersection of two or more lines). Then, with the palm of your hand, you hold the punch in vertical position, pressing it down slightly. You then raise the movable washer with two fingers (if washer is large enough: with four fingers) compressing the spring to the maximum. Now, releasing the washer suddenly—still holding the punch with the palm of the hand—the expanding spring strikes the washer against the bottom pin, and the punch-point receives—through the punch-body—quite an impact which produces a nice centre-mark in the work-piece.

—F. STRASSER.

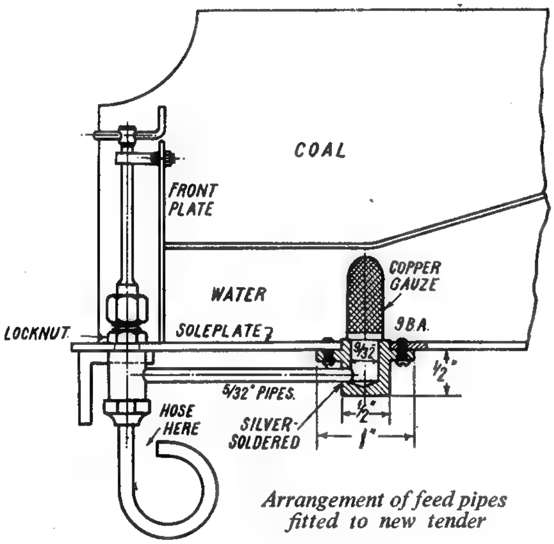


L.B.S.C.'s Lobby Chat

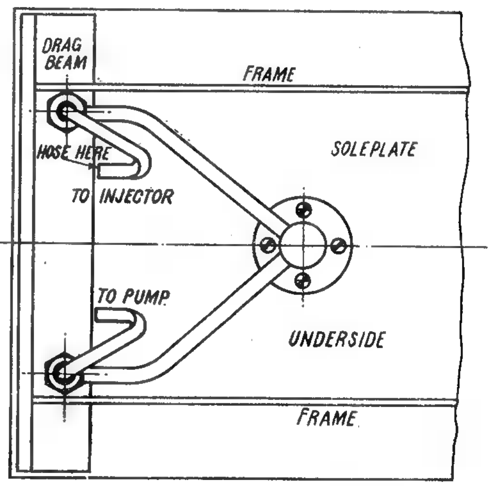
● SIMPLIFYING THE PLUMBING

OLDER readers of this journal may recollect that just over eighteen years ago, I built a 2½-in. gauge 4-6-2 which I called *Fernanda*. She was similar to old *Fayette* in general dimensions, but in appearance she belonged to the L.M.S. family. She had piston-valve cylinders, Stephenson link motion of the Great Western type, with launch links, and every axle of both engine and tender was carried on ball bearings. The tender, unlike anything on the L.M.S., was a huge bogie "water-cart" which, in full size, would have carried about 15,000 gallons, and enough coal to last a housewife about two years at least. She hasn't any injector, the boiler being fed by an eccentric-driven pump, and a Weir-type donkey pump. In all the years she has run, she has never given any trouble, and can still pull four adults at a high speed on very little coal and water; the ball-bearing axles make her almost frictionless, and she has coasted nearly a circuit of my line with steam off. The only repair she has ever needed, was a new shuttle to the donkey-pump; the old one began to wear (it is only 5/32 in. diameter at the bobbins) so I made a new one in a matter of minutes from a piece of 5/32-in. ground rustless steel, and that put matters O.K.

Just recently, I thought it was about time that I took a look at the pistons. The cylinder covers had never been off since the day she made her first trial trip. I found the pistons and bores in excellent condition; but after all that time, the packing had become very soft, so I replaced it with a ring of braided graphited yarn on each piston. I also took off the experimental slide-crank mechanical lubricator which had served her well, down the years, and put on one of my "standard" oscillating-cylinder type, with a smaller ram. The original one always supplied more oil than necessary; I made it so, in the first place, on account of the piston-valves, because at that time I had not had much experience of how weeny piston-valves would stand up to "hard graft," and as followers of these notes know, I believe in "red-hot" steam. However, I need have had no fears, for she always threw drops of oil from the chimney when pulling hard, as my face and overall usually testified.



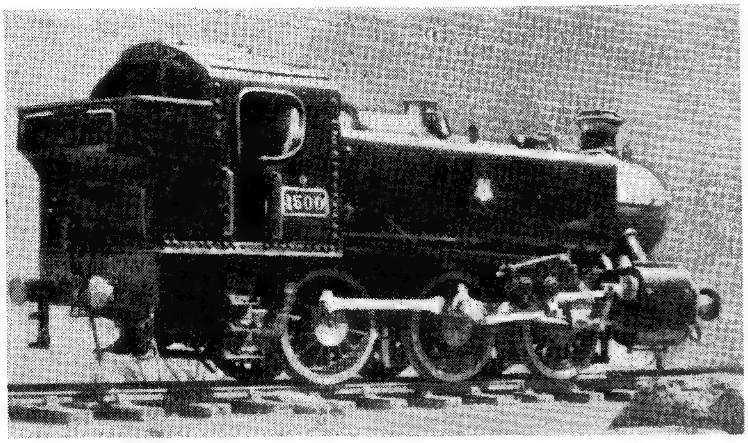
Arrangement of feed pipes fitted to new tender



Pipes, strainer and valves form a single unit

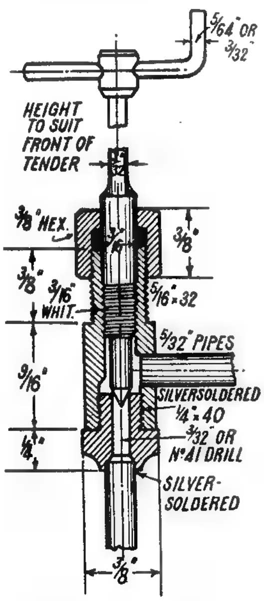
Long Arms Needed!

There was one thing about *Fernanda* which didn't worry me overmuch, but it worried the few other folk who drove her occasionally, and that was the long tender. My method of driving, was to set the regulator about half open, bring the reversing nut back almost to middle, and leave her to it. When she needed firing, which wasn't often, I could open the firehole door with the shovel, as it only has a light catch, pop in a couple of shovelfuls without leaning over, and shut the door again with the shovel blade. I only gave her enough to cover the bars, and keep her just at blowing-off pressure; too much fire meant keeping the door open a bit, otherwise she would blow off skyhigh. However, strange drivers who weren't used to locomotives performing on a breath of steam, themselves performed all the usual antics, fiddling about with regulator and reversing-gear, turning the pump bypass on and off, and usually putting too much coal on, so that they had to be continually opening and shutting the firehole door. A long-armed gorilla could have performed all these tricks without shifting his anatomy from the middle of the driving car; not so, the strange drivers. They leaned over the long tender, to get at the cab fittings and the firehole, and



Mr. L. H. Woodhead's 2½ in. gauge G.W.R. "pug"

either tipped up the driving car, or leaned their hands heavily on the tender, and caused it to tilt sideways, either antic usually causing a complete derailment. Being the one-person permanent-way gang, I don't relish having to replace broken sleepers and torn-out screws.



Section of water-valve

I once let an overseas visitor drive on my road ; he "went mad," in a manner of speaking, and the casualties were 23 sleepers and over 100 screws to replace. Never again ! The slap-happy speed-merchant didn't pause to think that when he came off the road, the wheel flanges would dig into the sleepers; split them, and tear off screw-heads, owing to the weight of about 25 full-sized coaches, in proportion, being carried on four axles only ; and if he DID—well, why should *he* worry, anyway ? It wasn't his railway, and he didn't have to bother about the repairs !

Incidentally, this is one reason why I am now chary of letting strangers run on my road. I'm used to it, and can take an engine round at a very high speed in perfect safety ; but one has to know the knack. Another reason is, that "foreign" engines invariably smother the rail-heads with oil and grease ; and before I can run engines like *Grosvenor* or *Jeanie Deans*, the whole circuit has to be cleaned with petrol and a chunk of felt ; and petrol costs an awfu' lot o' bawbees the noo, ye ken, besides the back-breaking and arm-aching job itself. Dumping sand on top of the oil, not only messes up the wheels of my engines, but stops the signals from working, as the track-circuit current won't run through the oil-grease-sand mixture. Many full-sized engines are now provided with a hot-water jet to wash sand off the rails after the driving wheels have been over it. My own locomotives don't drop oil on the rails ; they use it instead—frugal lassies !

On the Spur of the Moment

On the first run after her "shed day," the engine was soon reeling off the laps in her usual effortless way ; and sitting behind her on the little car, with practically nothing to do, I recalled, with a smile, the way other folk drove her. It crossed my mind that they would do better if the tender weren't so long ; and then I thought "Well, why on earth don't I make a shorter tender? —I've plenty of material." Being one of those folk who act on impulse, I promptly set to work and did it. The old saw says, "a change of work is the best rest"; and as I seemed to be making little or no progress with the jobs in hand—life nowadays seems to be just one darned thing after another !—I thought the change might buck me up a bit. It did, too !

To render the cab as accessible as possible, I copied the smallest of the main-line L.M.S. tenders, as fitted to the first *Princess Royal* ; this carried 3,500 gallons of water, and 5½ tons of coal, and was later replaced by the 4,000-gal.—9-ton type. There is no need to detail out the construction, as it followed what might be called the Curly standard practice. The frames were steel plate, the buffer and drag beams of steel angle, the whole lot being Sifbronzed. I didn't bother about fitting ball bearings, having some ordinary cast horns and dummy springs, so I used them, with plain-bearing bronze axleboxes, and spiral springs in the hoops of the cast dummies. The whole of the superstructure, with the exception of a 16-gauge soleplate, was made from 20-gauge sheet brass, angled and riveted, the joints being soldered also, where necessary to prevent leakage of water. An emergency hand-pump was fitted in the tank as usual ; but when I came to the pipe work—here, thought I, is a fine chance to simplify the layout, which was done.

New Pipe Arrangement

The water supply for the donkey-pump on *Fernanda* was originally taken from a T-joint on the feed pipe to the eccentric-driven pump; and if both were operated together, either one or the other was "starved" of water (says Pat). The boiler never worried; it would make steam against both pumps if necessary. To make the water connections exactly the same as on the other engines, which have injectors, and to render the tender interchangeable, I altered the feeds, separating them, and bringing the connection for the donkey-pump, to the point where I fit the injector feed pipe. In place of two strainers in the tender tank, I fitted one only, a big one, with a well underneath, and two 5/32-in. pipes went from this well, to two $\frac{3}{16}$-in. screw-down valves just in front of the tank, one at each side of the coal gate. The upper part of these valves passed through holes in the top of the drag beam, and were secured by

locknuts. The stems of the valve pins were thinned down for most of their length, and furnished with hand-brake pattern handles; the stems were each supported by [redacted] bracket underneath. The outlet pipes from the valves were formed into complete loops, which not only eliminated sharp bends, but allowed for a longer "feed-bag," or hose connection, rendering the engine more flexible, and the hoses less likely to split. The arrangement is shown in the accompanying illustration.

The whole issue is instantly detachable for cleaning, emergency repair, or any other reason. The valve pins are run out of the valves, the gland and locknuts unscrewed, and the four screws taken out of the strainer flange; the complete assembly can then be lifted clear. There is, of course, no real need for a valve at all, on the pipe feeding the eccentric-driven pump, as it pumps all the time, and surplus water is returned to the tank via the bypass valve; but with [redacted] valve on the pipe, the tender need not be drained out if any water should be left in after a run. It should never be used, on a small engine, for throttling the water supply.

Quick-acting Valves

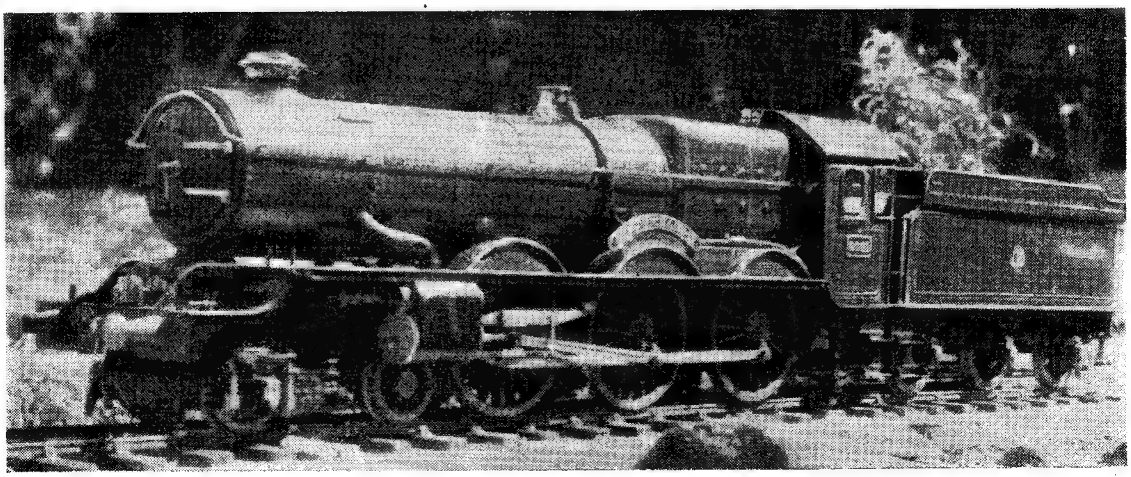
There was another variation I made, in the valves themselves; in place of the one-piece construction, they were made in two pieces, in the same manner as full-size screwdown or globe valves. The object of this, was to give [redacted] quicker action, as there is more space around the valve itself, for the water to pass; this, plus the quick lift of [redacted] $\frac{3}{16}$-in. Whitworth thread, gives practically a full opening with [redacted] turn of the handle. This is very desirable when operating an injector when the engine is running; and I shall probably [redacted] this tender, behind old *Ayesha*, when I do some more injector-testing, [redacted] it holds more water than her own. The old girl will be wondering what's happening, running with a L.M.S. tender; probably she'll fancy that she is going on an interchange trial, like the "spam-cans" when they were temporarily fitted with L.M.S. tenders for running on that road, and on the G.W.R.

The new tender suits *Fernanda* very well; it not only renders the cab more accessible, and makes driving easier for the handle-twiddlers, but the old lady looks much more L.M.S.-ish; she is now "in the fashion" with all her big sisters, which have six-wheeled tenders. I can't resist telling you about the posh buffers on the new tender; I'd run out of $\frac{5}{8}$-in. "screw-rod," and ditto mild-steel, but I have plenty of $\frac{5}{8}$-in. round phosphor-bronze, and also some drawn machinable rustless steel of same diameter (relics of my shopping trips in town on the gasoline buggy, in days now long past) so I turned the buffer sockets from the bronze, and the heads from the rustless steel—oh, boy!

Continuous Brakes on Small Rolling Stock

Our worthy—and Worthing—friend, Bro. Hyphen, "father of twins," occasionally refers to your humble servant in his articles in this journal, e.g., the question of lamp brackets on shunting engines; [redacted] maybe I may be permitted to return the compliment. In January 15th issue, he refers to continuous brakes on small rolling-stock, [redacted] an apparent "dream of the future." It looks to me [redacted] though he has been doing [redacted] bit of dreaming himself, so let's wake him up with a friendly poke in the ribs.

In both this journal, and a contemporary, I have described both the vacuum brake, and the air brake, and given instructions on how to fit both, to locomotives and cars. As to the efficiency of ejectors, how does this strike him? During the war, [redacted] firm in the Midlands made some vacuum-operated valves and switches for aircraft and other use; and instead of installing expensive apparatus to test them, the manager made up [redacted] few of my vacuum-brake ejectors, as described in this journal. They did the trick, thereby saving the firm considerable expense; and in recognition, the manager sent me [redacted] peach of a machine-vice, which has been in use ever since, and is, at this very minute, on the table of my pillar drilling-machine. I also made up a weeny ejector for demonstration purposes, and sent it to the Editor of the *Locomotive Express*, himself an old L.N.E.R. driver in the Scottish area. The business part of this was only $\frac{3}{4}$ in. long, yet by blowing into the steam end, just with your breath, it created enough "wack-um," as they call it in Norfolk, to lift water six inches high, out of a tea-cup, and spray it out of the exhaust. What it would do under steam, goodness only knows; probably suck the needle of [redacted] vacuum



Mr. L. H. Woodhead's $2\frac{1}{2}$ in. gauge 4-cylinder "King"

gauge to the end of the scale. The worthy Editor gave it to a locomoive inspector who was also a M.I.C. instructor (he couldn't help himself—the latter "commandeered" it !) and I understand that it has been demonstrated at practically all the locomotive running-sheds—I beg their pardon; "motive power depots"—ha, hum !—in the Scottish Region of B.R.

Our friend refers to the "triple valve" as part of the vacuum-brake equipment. May I inform him, with all due respect, *that the triple valve is one of the components of the Westinghouse air brake*, and is not found in vacuum-brake equipment at all ? The automatic action of the vacuum brake is obtained by the use of a simple ball-valve on each brake cylinder. As to the brake linkage and rodding of a bogie coach, if he can improve on the arrangement used in full-size practice, which is easy to copy, even in 2½-in. gauge, I guess British Railways would find him a high position right away.

Drawings

Just one more point. Bro. Hyphen in rendering praise to his drawing board (at which he says he cannot stand, yet he could stand at lathe and bench, otherwise how did he finish his "t win" ?) says that he set out his valve-gear, and made all parts to the advertised centres, and they fitted like a jigsaw puzzle. If that were the case, how is it that he did not include the drawing in his articles, and so give others who were building the twins, an opportunity of following suit ? I have never had a lesson in mechanical draughtsmanship in my life; but I lay out my valve-gear for every engine described in these notes, and the drawing is published, for the full benefit and guidance of all who are building the locomotives. I can—and do—build locomotives without a pencilled line; but I don't expect those who rely on these notes for instruction, to do the same. 'Nuff sed !

Superheaters and Cylinders

With regard to Mr. Keiller's further letter on the above subjects, in January 15th issue, there is just one point that has probably not occurred to our esteemed friend. His position in life was—and is—vastly different to my own, He probably never knew what it was, to have to fight and struggle, in a manner of speaking, for the wherewithal to live, let alone spend money on experimental work; and between the dates he mentioned, 1900 to 1922, my life was what we would have called, on the railway, one continual rough shunt. When the Drummond lathes came out (in 1902 if memory serves me right) I coveted one, with an intense longing. How to get it ? The price (£13 10s. 0d.) was equivalent to a young fortune to poor Curly ! But that individual never lacked enterprise. Even the "down payment and so-much-per-month" in the advertisements, was beyond my resources; so I decided to go to Guildford and see Arthur Drummond himself, and explain matters. *He let me have one for ten-shillings-and-sixpence per month*, and sent it before I had paid one penny, accepting the loco-yard foreman as reference. I never missed an instalment, earning enough to pay, by odd jobs such as gramophone repairing.

Making Do

What has this to do with superheaters, you may ask ? Just this—I had to make do *with what I could get, not what I wanted*, when locomotive-building, in the early days of the twentieth century, and was lucky to get anything at all. Even in the later years, it was largely a question of "make-do." The sizes of *Ayesha's* tubes and flue were determined by circumstances. For a silly price, I acquired part of a bus radiator damaged by collision, and got enough tubes out of it for several boilers, including *Ayesha's*. I happened to have a piece of ½-in. tube of requisite thickness, and used it for the superheater flue. That is all there is to it ! *Ayesha's* second boiler, the one she has now, has a ⅞-in. flue, ¼-in. element, with block return-bend, and is an improvement on the original; she still has seven ⅜-in. ordinary tubes.

I wouldn't dispute for one minute, a statement that others may have tried a steam-drying loop in the single flue of an Alexander-type boiler. All I can say is, that if such was the case, I didn't know of it. What I did, was to aim for dry steam, and greater efficiency, by using a bit of ordinary common sense, with no thought of "being clever" ; but for all that, the simple loop in the flue, was the great grand-nanny of the modern superheater !

Regarding cylinders, Mr. Averill told me that he definitely DID fit a circular steamchest at the turn of the century, and told Mr. Greenly all about it. As to blast nozzle sizes, dare I suggest that maybe my engines use less steam than Mr. Keiller's, and need smaller nozzles to obtain sufficient exhaust velocity ? It would be hard luck if the exhaust steam fell down inside the smokebox ! Finally, if live passenger hauling was practised by tiny locomotives prior to *Ayesha's* time, why was I called a D.L. when I said she could do it ?

MODEL RAILWAY CLUB EXHIBITION—1953

THIS exhibition will be held as usual in the Central Hall, Westminster from April 7th to 11th inclusive (Easter week). It is believed to be the largest amateur organised exhibition in the world and it is proposed to keep it open one hour longer each day than of recent years. It will be open at mid-day to the Press, at 2 p.m. to the public on Tuesday, April 7th, and at 10.30 a.m. on the other days, closing at 9.30 p.m. each night.

The layout of the Upper Hall has been re-arranged. This should ease the flow of visitors through the hall. The club's own gauge "O" fine-scale layout, which has been enlarged since it was last shown, will be operating free of charge as usual. More provincial clubs have been invited to take part, among them are Folkestone, Manchester, Merseyside, Leicester, Birmingham, Chester and Leeds. The layout of the space available to the trade has been amended and improved displays should result.

The Railway Club has kindly agreed to lend its collection of crests and relics which will be displayed on the dais.

The layout of the Lower Hall has also been amended, British Railways' model railway forming the centrepiece. The facilities for the trade have also been improved in this hall. A ¾-in. scale tramway layout will be shown in operation, also a complete 2 mm. scale railway, a 4 mm. scale model of a 3 ft. gauge prototype, and a 4 mm. scale model of a section of the Tal-y-llyn Railway. An improved version of the gauge "1" layout shown last year will also be operating.

Small-scale iron founding

By Terry Aspin

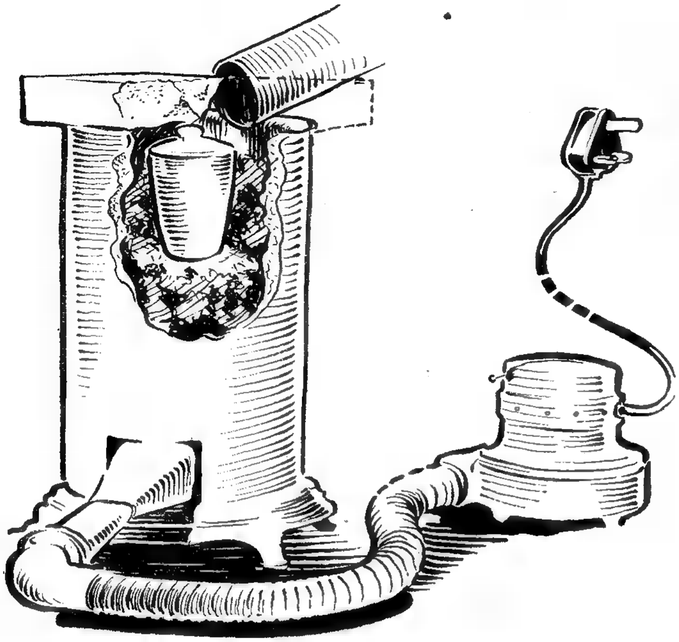


Fig. 1. Diagrammatic sketch of the furnace arrangements

I PROPOSE to outline the method by which, over the past few years, I have repeatedly made successful iron castings in the simplest of home foundries.

For this purpose I have used ordinary two-pound, four-pound and six-pound plumbago crucibles obtainable in small numbers from Messrs. James C. Waterhouse Ltd., Soho Works, Wakefield, Yorks. I deliberately mention the name of my supplier, because it is my experience that, with descriptive articles of this kind the reader is frequently left in the air regarding the equipment specified and where it can be obtained.

These crucibles have given me the most remarkable service. Only one has broken in the furnace with a loss of metal, and that after somewhere approaching a hundred and fifty melts. By that time it was little more than a clinker shell of its former self, so I should have been warned. At half-a-crown each this represents an infinitesimal cost per casting.

The melting point of cast-iron (as given in *Fowler's Mechanic's and Machinist's Pocket Book.*) is 1,900 deg. Fah. The heat required for pouring is probably a little more, and my furnace for obtaining this heat consists of a small, slow-combustion stove, about eighteen inches high, with the cast-iron top removed. (Fig. 1). The stovepipe rests on the rear edge of this and a rough, sheet-iron cowl placed over the top of the open stove assists in drawing away the smoke when the fire is being lit. It also helps to create a natural draught that assists the firewood to ignite the coke. I use ordinary gas coke. It forms a great deal of clinker; undoubtedly, if superior coke were available, better results could be obtained; but the heat given is quite adequate for iron. (Quite incidentally, I firmly believe I could melt steel if I used foundry coke !)

Forced draught is directed into the bottom opening of the stove, and for supplying the current of air I used, in the first instance, a vacuum cleaner and, later, an ex-A.M. Hoover blower, which I obtained for this purpose at a cost of about

Three clinker-encrusted crucibles, heroes of many heats, with an unused one in the fore

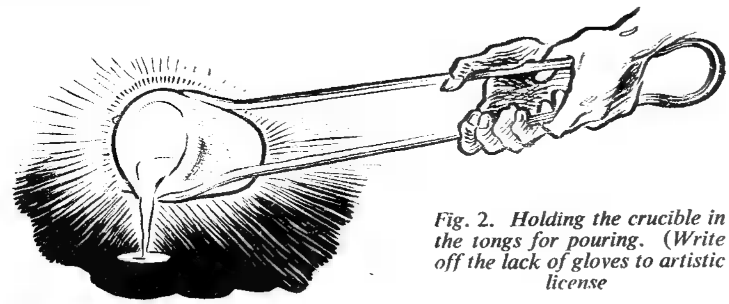


Fig. 2. Holding the crucible in the tongs for pouring. (Write off the lack of gloves to artistic license

fifty-five shillings. It has proved very satisfactory without the attendant risk of domestic upheaval !

When the coke is fairly alight, the draught is applied and the content of the furnace is rapidly blown up to an incandescent, white heat. Small coke is added until the white-hot fuel comes to within the height of a crucible of the top. I always find it more satisfactory to pre-heat the furnace in this way before the crucible of iron is added. The coke can be rammed down fairly tightly to give a really solid foundation of fire for the crucible to rest on. This packing of the bottom coke also helps to avoid the likelihood of a hole being blown right through the fuel under the crucible, thereby quickly lowering the temperature instead of raising it.

During any operation upon the furnace, of course, the draught is shut off. Imagine playing about with the business end of a lighted blowlamp having a mouth of ten inches diameter—for that is what it resembles!

Now the crucible can be put in but, first, of course, it must be filled with iron. For the initial melt I use small fragments, broken piston rings, pieces of guttering and down-spouting, etc., which can be conveniently split : larger pieces can better be added after a pool of liquid has been formed. The crucible is packed as full as possible without wedging. Allowance has to be made for the expansion of the metal, or the crucible would be cracked.

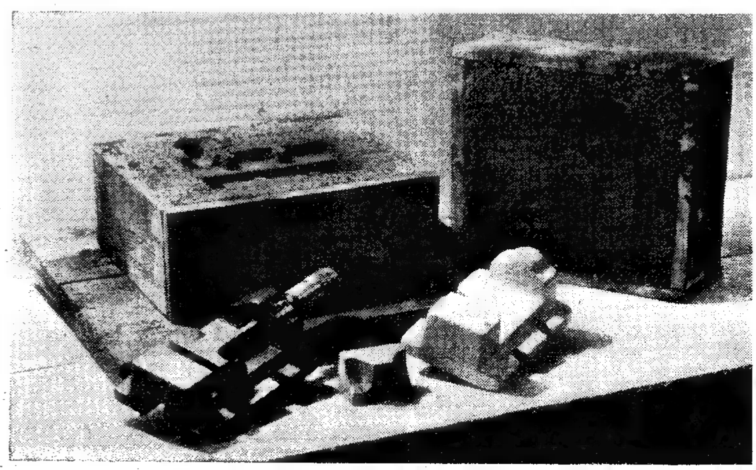
The pot with its lid on can now be placed in the furnace and packed well round with small coke. The sheet-iron cowl is exchanged for a slab of firebrick and the draught applied again. For handling the crucible, etc., I use a pair of home-made tongs (Fig. 2) roughly resembling sugar tongs; made from $\frac{3}{8}$ in. reinforcing steel. Flat bar would be better. The shape is simple and a possible advantage it has over the pincer type is the difficulty in applying excessive pressure, thereby preserving the crucible. The loss of the pot itself may not be a crippling financial one, but it is of an extremely annoying nature when the melted content thereof is also involved after the energy expended in reducing it to that state. I may have lost only one melt through a breakage but there are other forms of accident before the casting is finally rotating in the four-jaw chuck.

To reduce the iron to a milky pool in the bottom of the crucible will take from ten to twenty minutes, according to the size of vessel used. The time compares favourably with that required in commercial furnaces of larger capacity. Progress can be noted with the naked eye by lifting the furnace top a little with the draught still on. Even though the crucible may be getting from red to white itself, it is too early to disturb it while the space between the crucible and lid still appears as a darker line. It is not until the whole fire and its contents are fused into a brilliant white mass that the iron can be assumed to have melted.

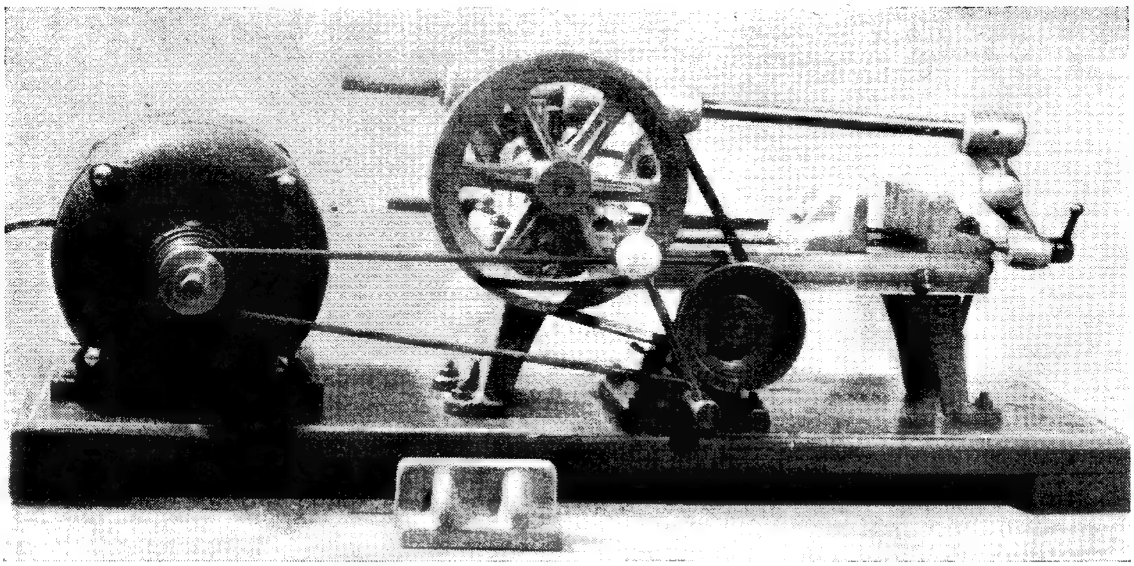
The draught can now be shut off and the contents of the crucible examined. Probably, when first the lid is raised, the iron will appear to be unmelted and almost to fill the pot but, when a stirring-rod is introduced into it, this will be seen to consist of a fragile crust of empty, oxidised shells from which the molten iron has run. A quick stir will reveal the shimmering, molten metal underneath and the slag can be lifted away with a " spoon."

The furnace will also need replenishing, and for this purpose the crucible will have to be raised with the tongs, and more small coke packed underneath and around the sides again. The top will have to be replaced and the furnace blown up to a white heat once more and, if a full crucible is required, the replenishing will probably have to be repeated a second time before the iron is finally poured. I find it wiser to make sure of a surplus of metal rather than too little which, of course, is utterly useless.

Before the iron is poured it must be well stirred and skimmed. For this purpose a long rod and " spoon " (previously mentioned) are required and a pair of old gloves will come in handy, for the heat is pretty fierce. Separate tools are necessary as, if the spoon is used for stirring, as if it were tea in a cup, it will simply add itself to the liquid in the pot and disappear in a few seconds. It is most important to skim the iron clean, or the shale will probably materialise as the upper surface of that otherwise beautiful casting. There is relatively plenty of time for this operation, as the iron, although loosing heat visibly, remains nicely liquid in the furnace for a remarkable length of time. At this stage convection currents are visible in the metal which appears to be simmering, as if almost on the boil. Time taken



The prepared mould, the pattern and a finished machine vice



A hacksaw of original design, only the vice jaws of which are in iron. All other parts, including pulleys are cast in aluminium purely from choice

n skimming is not wasted for, if the iron is poured too hot, a hard, chilled surface is imparted to the casting which renders it almost impervious to ordinary cutting tools. Here judgment, born of experience, helps a lot.

After early efforts at moudling using ordinary builders' sand, I finally plucked up enough courage to visit a local foundry and beg a box full of the real M'Coy. From the same source I acquired a quantity of core sand and a little of the graphite powder used for dusting the inside of the mould.

For iron casting, great care must be taken to have the sand just sufficiently moist. A test is to squeeze a handful in the fist and then break the cake so formed in two. The fracture should be clean and sharp. At the same time the presence of over abundant moisture will be indicated by a tendency for the sand to adhere to the hands. Sand *feeling* wet should not be used and can be dangerous. The mould becomes a spectacular "piccolo vesuvio" when the metal is poured into it, and the natural reaction to become an absentee has a very urgent quality. Damp cores have a similar effect and are, therefore, to be avoided.

Another form of accident is the result of neglecting to weight evenly and securely the top of the moulding box before pouring. This applies particularly when the casting is of relatively heavy section. The head of iron is liable to cause the upper storey to lift and the white-hot metal runs away in merry little streams. I have witnessed no real damage caused in this way, but I am fully alive to the possibilities of it.

My moulding boxes (Yes! I know they are officially known as "flasks") are nailed together in a few minutes from packing-case wood. No special carpentry skill was required for their production, beyond a vague acquaintance with the blunt end of a hammer and the sharp end of a nail. Location of the two halves is by two beheaded nails in the upper and suitably drilled holes in the lower edges of the wood. The rough interiors of the boxes help to resist the tendency of the sand to leave them during the moulding process and, though my boxes bear the scars of many a runaway, they still do their duty admirably. I have four or five different sizes, the largest of them taking a pulley wheel pattern six inches in diameter. In it were also cast the bases for a "Kennedy" type tube bender of which three sets were produced in my foundry.

My moulding tools are exceeded only by the boxes in their simplicity. For iron they consist of a short length of brush stick for ramming; about 5 in. of $\frac{1}{2}$-in. diameter brass gas pipe for forming the runner; an old screwdriver $\frac{1}{8}$ in. diameter serves for making vents and a pair of small trowels specially made for cutting the gates and fettling respectively. A $\frac{1}{4}$ in. mesh garden seive is used for sifting the moulding sand: a small domestic seive for spreading the parting sand, for which I use dried builders' sand, and a small coffee strainer is used for dusting graphite into the moulds. Oh! and a sable paint brush, relic of bygone days, for moistening the sand surrounding the pattern to aid in securing a clean draw.

I have occasionally used other people's patterns but, generally, I make my own. Here again carpentry takes a back seat but, however, I do attempt to produce patterns of good appearance and adequate section and, as far as I am able I construct them, with an eye to ensuring as simple a moulding operation as possible. This latter quality makes for success. Here you have the perfect liaison between pattern maker and moulder—one man does both! I usually finish the patterns with a coat of cellulose filler sprayed on, with perhaps, a thin coat of gloss, paying particular attention to the smoothness of the sides where the pattern is going to leave the mould. Those intended for "oddsides" are made with their more intricate sides to be drawn from the bottom half of the mould, allowing the top to be lifted from as simple a contour as possible, thus minimising damage.

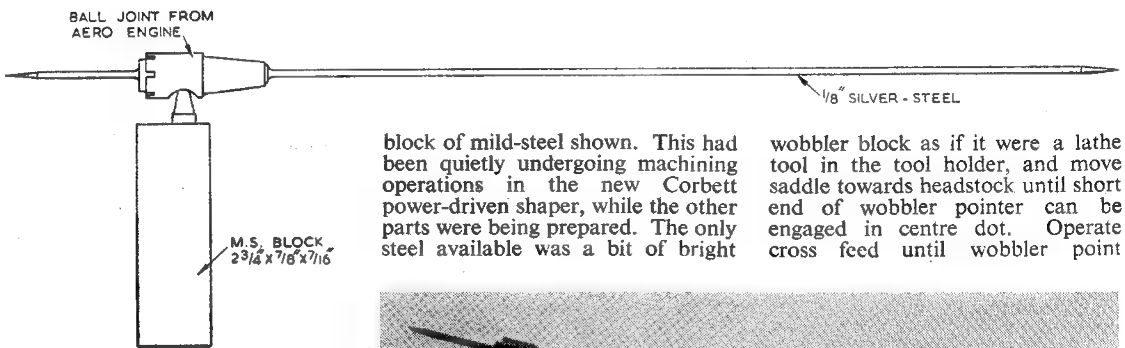
An ancient "Hobbies" jig saw forms a valuable ally in my pattern making. It comfortably handles soft woods up to an inch in thickness and the table can be tilted so that the draught angle is cut out auto-

(Continued on next page)

A simply constructed wobbler

By J. Irvine Carswell

IT is good practice to make up a tool for the job when a need arises. When I started to centre the crankpin of the " Busy Bee " engine, I felt the urgent need of a wobbler and it seemed worth while to stop everything and produce one, rather than spend a considerable time endeavouring to get a centre-dot truly central by hit-and-miss methods.



The action of the tool proved so simple, rapid and accurate that it is suggested as a worth-while " quickie " when an hour's release from work in hand is desired.

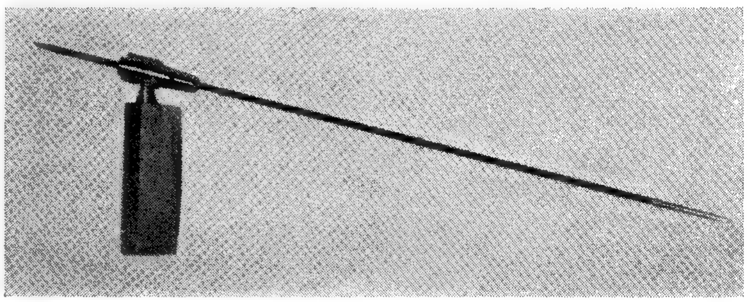
A package of Rolls-Royce aero engine ball-joints had been purchased at a throw-away price from a MODEL ENGINEER advertiser some time ago. One of these was unwrapped and stripped down. A 13 in. length of $\frac{1}{8}$ in. silver-steel rod was sawn through 2 in. from one end. Each piece was ground to a point, set in the self-centring chuck and with the lathe on top speed, the point was smoothed down with a carborundum slip.

The screwed socket had the screwdriver slot ground away. It was then caught in the self-centring chuck and centre-drilled No. 29; likewise a No. 2-B.A. bolt was screwed into the control-rod end of the joint sawn off nearly flush, removed, centre-drilled, then drilled for about $\frac{1}{4}$ in. with No. 29 drill.

These screwed ends were firmly fixed to the silver-steel pointers by a touch of Easyflo, and a few seconds in the oxy-acetylene flame.

Holding the male cup in the chuck had just sufficiently roughened the threads to make it a tightish fit in the female shank, so that there was no need to consider replacing the split-pin, while the bolt end used for the other pointer could be screwed in to bottom and thus also secured.

The ball end was screwed into the block of mild-steel shown. This had been quietly undergoing machining operations in the new Corbett power-driven shaper, while the other parts were being prepared. The only steel available was a bit of bright



$1\frac{1}{2}$ in. by $\frac{1}{2}$ in. bar and this was planed down to $\frac{7}{8}$ in. by $\frac{7}{16}$ in. section without physical effort or tediousness, one of the very great advantages of a small power shaper.

A back centre in the lathe tailstock was used to scribe the height for drilling the hole for the ball end, which was then centre-punched, centre-drilled, drilled No. 22, tapped No. 2 B.S.F., and counter-drilled No. 10 for a sufficient depth to allow the ball end to be screwed up to the shoulder provided.

The steel block was draw-filed with a fine file, not that this was really essential, all edges and corners rounded and the whole of the parts polished with worn fine-grade emery cloth.

Assembled with a spot of oil and a little careful adjustment, this very simple wobbler proved a revelation in ease of operation, while the time taken to obtain a spot on setting is most satisfyingly short.

The technique is simple; set punch-mark to be centred at approximately the proper position. Clamp wobbler block as if it were a lathe tool in the tool holder, and move saddle towards headstock until short end of wobbler pointer can be engaged in centre dot. Operate cross feed until wobbler point scribes a circle round tailstock centre, which is brought into position with the centre and the pointer almost touching, the lathe being turned at slow speed.

The job on the faceplate is now tapped gently until the wobbler point is coincident with the point of the tailstock centre and the clamping bolts tightened slightly.

Small-scale iron founding

(Continued from previous page)

matically while the outline is being followed by the blade. The fine fret saws leave the edges of the wood smooth, requiring very little cleaning up and, used for piercing, it enables spoked wheels and so on to be cut from the solid—usually after the disc of wood has been turned to the required section on the lathe. Now, don't be shocked at this reference to spoked wheels being cut from the solid! Warping? Not likely! A master pattern can immediately be made in the form of an aluminium casting, and I would like to see even *our British* climate warping that to any measurable extent!

(To be concluded)

READERS' LETTERS

Letters of general interest on all subjects relating to model engineering are welcomed. A nom de plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

EYE PROTECTION

DEAR SIR,—I cannot help feeling surprised that Mr. Eddy, who is a fellow optician I believe, should advise plastic lenses for model engineer's spectacles (Jan. 22nd issue). Whereas I agree that some form of protection would be desirable and that plastic lenses are an excellent product, the surface of these lenses is comparatively soft and rather prone to scratches. My experience is that if engineers *do* use a spectacle case for the spectacles when not in use, it invariably contains some iron filings or other abrasive matter; otherwise, they get put in a pocket along with pliers, screwdrivers, etc., or left on the bench with numerous bits and pieces, filings, metal turnings, etc. Under these conditions, I'm afraid the surface of the lenses would be ruined in a very short time.

I think that a much more practical proposition would be laminated safety lenses, made on the same principle as "triplex" windscreens. These will crack if they get a hard enough blow, but will not shatter or splinter. The cost would be a bit higher, but I think they should outlast several pairs of plastic lenses unless the owner was extremely careful with the latter.

Yours faithfully,

Weymouth. W. C. L. BEAVIS.

PRECISION DRILLING MACHINE

DEAR SIR,—Mr. Mellows set himself the fairly fine limit of 0.0005 in. which is all to the good but, having provided himself with a ground column $1\frac{1}{2}$ in. diameter, why did he immediately impair its accuracy by turning down the ends? I am prepared to maintain that a bar cannot be "truly centred" by any means available to the amateur—certainly not to within the half-thousandth prescribed. The only method that occurs to me would employ a collet chuck and a lathe having a mandrel bore large enough to take the column, but given such a lathe the column ends could be turned down straightaway and there would be no need for centring! Surely the headstock boss at $2\frac{1}{8}$ in. diameter would have given sufficient wall thickness at $\frac{5}{16}$ in. to have permitted boring it out to the full $1\frac{1}{2}$ in.? Likewise the boss on the base casting at $2\frac{1}{2}$ in. diameter would have allowed $\frac{1}{2}$ in. wall thickness.

Mr. Mellows obviously expects his machine to maintain its initial accuracy but I fear he will be disappointed in some respects. The fitting of ball races will do much to minimise wear but I consider that the sleeve for the spindle should have been lapped outside, together with the bore of the headstock boss in which it slides. However fine a feed is used in finish-turning, if the surface is examined under a strong magnifying glass it will be seen to consist of alternate troughs and ridges. Now the ridges will wear down to the level of the solid metal in sleeve and bore alike and what will have happened to that half thou. limit then? The sliding portion of the drill spindle should also be lapped, together with the member in which it slides, apparently the driving cone pulley.

I should like to make a comment on the design of the sliding table. Whilst Mr. Mellows is the best judge of his requirements, I suggest that the drilling of holes at an angle to base occurs at such infrequent intervals that it seems a pity to weaken this part of the machine by introducing another joint. When all is said and done, the effective diameter of the bracket support for the table is only the $\frac{3}{4}$ in. diameter stalk, and drilling pressure occurs over 3 in. away from the point of support. To drill $\frac{5}{16}$ in. holes in steel plate requires considerable pressure and I should like to suggest to Mr. Mellows that he makes a test by simulating the drilling of a hole by placing a piece of rod—or a drill—in the chuck and resting the free end against a pad on the drill table. If he then tests for angularity as between table surface and column I am rather afraid he will have a shock.

One final point. I have always been under the impression that a "sensitive" drilling machine employs a hand or lever feed without the intervention of gearing. The use of gearing reduces very considerably the sensitivity the operator feels and the control he has, particularly when drilling the smaller sizes. Mr. Mellows' feed appears to have a leverage of about ten to one, which I think is rather rough on the smaller drills. His smallest size is about No. 70, which needs great delicacy of touch.

I have myself designed and built two drilling machines and like Mr. Mellows, my second embodied improvements over the first. I therefore advance these criticisms with some knowledge of the designing and machining considerations involved and hope, therefore, that your contributor will accept my comments accordingly.

Yours faithfully,

Croydon. L. A. WATSON.

THE SAVERY ENGINE

DEAR SIR,—In view of the interest which has been shown in the Savery engine which was awarded the championship cup for the general engineering section in the recent MODEL ENGINEER Exhibition, I felt that I should mention that we have on view at the present moment in this museum, a double expansion twin-cylinder Savery engine of a similar period to the one in question.

Yours faithfully,

N. W. BERTENSHAW.
City Museum and
Birmingham. Art Gallery.

WATER PUMPS

DEAR SIR,—With reference to the query from N.K.W. in THE MODEL ENGINEER of January 22nd, and your reply to same, I beg to suggest that the most suitable pump for the purpose would be a semi-rotary.

This could be used by hand at first as desired, and later, for the cost of a few shillings, adapted for driving by an internal combustion engine.

I have used this arrangement on several occasions, and have one which worked daily for five or six years, and now that I have made and fixed a deepwell pump, the semi-rotary one (driven by an electric motor) is used as a stand-by.

Yours faithfully,

Exmouth. A.D.S.

REFRIGERATOR MOTORS

DEAR SIR,—With reference to the query in the January 22nd issue from C.F.W. (Abbotts Leigh) concerning refrigerators, if this refrigerator is a BTH, I may be able to advise him on the matter, as I have dismantled one of these. The motor is not capacitor start, but has a separate starting winding, and a picture of this unit appears in THE MODEL ENGINEER, Vol. 69, p. 123. It is possible he could obviate the shock effect by reversing the supply leads.

Yours faithfully,
Moulton. W. A. WELLS.

THERMOMETER SCALES

DEAR SIR,—*Re* the letter by C.G.S.B. in the January 22nd issue, surely it is far simpler to use the formula 9C = 5(F − 32) than the one given by Mr. Weston.

$$9C = 5(F - 32)$$

Therefore if C is to equal F, they can both be called X.

$$\therefore 9X = 5X - 160$$
$$\text{,,} \quad 4X = -160$$
$$\text{,,} \quad X = -40.$$

Yours faithfully,
Ossett. COLIN W. RILEY.

CALENDAR CLOCKS

DEAR SIR,—I was very interested to see the description of Mr. W. H. C. Bradley's clock to the design of the late Dr. Bradbury Winter and would wish to congratulate him on a very fine piece of work.

I feel sure there are many readers who are interested in a high-class design of this sort and would ask you to consider very seriously publishing further details. Since, as Mr. Bradley says, Dr. Winter's drawings and instructions are in existence, surely it would be doing a lasting service to the memory of Dr. Winter that this material should be placed on record.

Detailed description and accurate drawings for this kind of work are hard to come by and never appear in the horological Press. Dr. Bradbury Winter's description of his Congreve clock and Mr. G. Gentry's articles, particularly of the long case clock in 1929, are really classics and are of permanent value.

Yours faithfully,
Leatherhead. J. H. HISCOCKS.

OLD TYPE DRUMMOND LATHES

DEAR SIR,—In view of your reply to the letter published under the heading "Queries and Replies" in the January 22nd issue of THE MODEL ENGINEER, from T. A. Sheffield, you may be interested in the following.

The so-called old pattern 4 in. "A" type round bed Drummond lathe which had the plummer block type headstock bearings in bronze bolted on to the top of the casting was discontinued in 1919 in favour of the later design in which the headstock casting was built up to include the bearings. On this later design the spindle ran direct in the cast-iron. There were, in fact, more of the old pattern machines built than of the new.

The 3½-in. flat-bed Drummond lathe, having the overarm on the headstock connecting the front and rear bearings was manufactured from 1912 to 1919 and was the "B" type machine. There was no ball thrust-race and the bearings were of a different design, as also was the arrangement for locking the cone pulley to the bull wheel for direct drive. As you will recall, the cone pulley was for round belt drive and we would add that the back gearing consisted of two pairs of 20 T. gears driving 60 T. wheels. The main point is, however, that the bearing design and the method of adjustment were entirely different.

There were no locking-screws *A* and *B* but simply plain oilers. Further, in place of the locking collars *D* and *E*, there were two plain washers, but these were between the bearings instead of outside them as on the "M" type headstock which you illustrate. Beside each pair of bearings there were two long cheesehead screws, the heads of which were at the outsides of the bearings, the other ends of the screws being threaded into tapped holes in the thrust washers. The bearings were closed on to the spindle simply by tightening these cheesehead screws. The thrust at the front end of the spindle was taken by the shoulder behind the chuck register, the end play adjustment being taken up by a collar similar to collar *C* on the "M" type headstock.

Yours faithfully,
For Myford Engineering Co. Ltd.
R. L. G. LOWNDES.
Sales Manager.

MODEL VACUUM BRAKES

DEAR SIR,—In Mr. Austen-Walton's article in a recent issue, the subject of vacuum brakes was discussed and your contributor states: "now we are getting somewhere." He also refers to a triple valve; surely this applies not to a vacuum but to a Westinghouse airbrake?

I feel that it may interest Mr. Austen-Walton and indeed your readers in general to know that for the last 11 years my engine and passenger trucks have been fitted with a fully automatic vacuum brake designed and made by myself.

My fellow-members of the Swansea Society of Model Engineers will support the statement that my brake has been quite trouble free and most vigorous in its action during the whole of this period. It has been used many times on the club's portable track at exhibitions where many of my friends who have acted as relief drivers have used it.

My engine is a 2-8-4T 3½-in. gauge, and if Mr. Austen-Walton would like to communicate with me and can arrange to meet me in Swansea where we have a 606-ft. continuous track, I would be pleased to hear from him through you, sir.

I should like to add that members of about six societies outside Swansea have seen and operated my brake.

Yours faithfully,
Swansea. S. A. FORD.

INSERTING SMALL SCREWS

DEAR SIR,—The article by W.J.S. on the above subject ("M.E.," January 22nd) interested me. In the early days of amateur wireless, we often used matchsticks to hold small nuts in difficult positions; we never arrived at anything more elaborate.

However, W.J.S. may be interested in a tip an old clockmaker gave me many years ago, to hold tiny screws so small that his dowel rods would not hold them. He used a thin strip of paper, the screw being just pushed through the end; as soon as the thread engaged, the paper was torn away and the screw tightened up.

Yours faithfully,
Bradford. J. C. HALL.

POWER FROM RAG!

DEAR SIR,—The following account, in the lighter vein, of an amusing experience in my workshop may be of interest to readers.

A friend, on being shown one of my locomotives, asked how the fire was kept alight in the small firebox.

I lit a piece of paraffin-soaked rag placed in the box, and with 50/60 lb. pressure from the air line in the boiler, the opening of the blower had the desired effect which was duly noted.

Then I opened the regulator, and blowing the whistle, the locomotive moved realistically along the bench to the following exclamation: "Just fancy, all that power from a small piece of rag!"

Yours faithfully,
Maidstone. S. T. LONGLEY.

SMALL WORKSHOP ELECTRIFICATION

Details of a comprehensive low voltage plant

By E. P. Crowdy

HOWEVER modest the home workshop, before long the need is felt for some form of motive power other than human muscles.

If a solution of this prime need can be coupled with an ability to drive electric motors at any speed from standstill to maximum revolutions, supplying power suitable for a model railway, charging accumulators, energising magnets or electroplating, all at a very low cost, the desirability of that particular solution will be greatly enhanced.

For a small workshop the advantages of a low voltage d.c. supply over the usual alternative of single phase a.c. are so numerous that if more than a single drive installation is contemplated, the d.c. plant described below should be seriously considered.

Every year thousands upon thousands of cars, buses, lorries, tanks and aeroplanes are scrapped, and every one has a low voltage generator and at least one low voltage motor with many years of useful life still to run. Thus it can be seen that a very plentiful supply of low voltage d.c. machines is available at very low cost indeed.

The plant described in this article shows an adaptation of a well-known circuit for generating a variable output from 0-100 volts and 0-100 amps. at the cost of one prime mover and a few pounds.

The Generating Set (Fig. 1)

This consists of a prime mover and two generators. The prime mover could well take the form of a steam or petrol engine, but in the actual set illustrated is a 1 h.p. single phase induction motor with an automatic capacitor starter. This motor, when coupled to the two generators, runs up to its working speed of 1,460 r.p.m. in approximately three seconds from connecting direct to the mains.

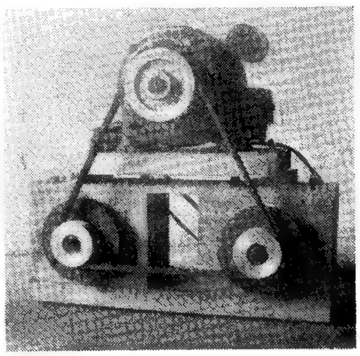


Fig. 1. The generating set

A high starting torque is not necessary and a starting winding on single phase induction motors could be dispensed with if the set was pulled over by hand to set it under way. If a suitable supply is available, a three phase squirrel cage induction motor would be ideal.

The two generators were obtained from an advertiser in THE MODEL ENGINEER and are of American origin ("Homelite") and are rated at 24 volts, 50 amps, 2,000-6,000 r.p.m., shunt wound for external voltage control. As supplied, they had a two-belt $\frac{5}{8}$ in. "V" pulley wheel cast integral with the fan at the opposite end to the commutator.

As these pulleys were on the large size, they were turned off and die cast aluminium pulleys for $\frac{1}{2}$-in. "V" belts shrunk on to the plain boss that remained. An interference fit of $1\frac{1}{2}/1,000$ in. per inch was allowed and french chalk dusted into the joint. The pulleys were heated on a hot plate and expanded the required amount whilst still cool enough to handle with a piece of rag. No signs of distortion or slip have manifested themselves and the belts run very evenly with no wobble.

A "V" belt drive was chosen, as a motor suitable for driving at both ends was not obtainable, and an in-line arrangement gives no choice in the speed of the driving motor.

The pulley sizes are such that the generators are driven at about 2,200 r.p.m., that is, just inside their declared working range.

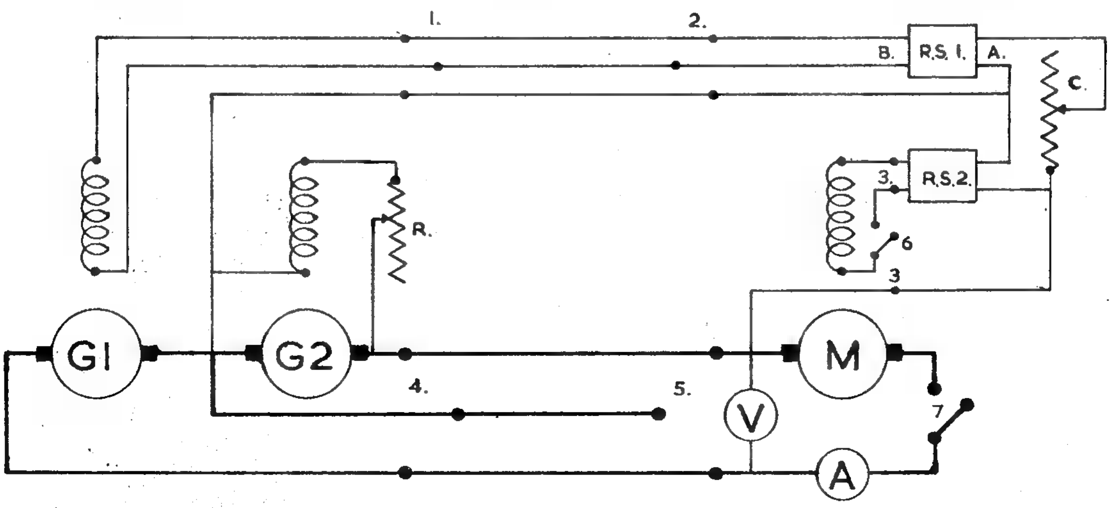


Fig. 2. The control circuit diagram

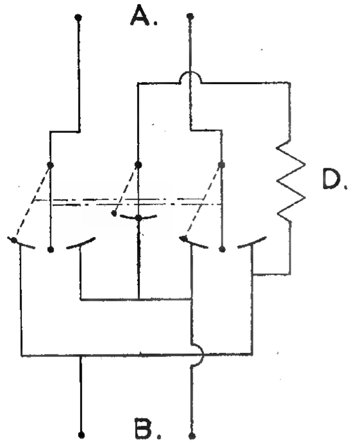


Fig. 3

The generators are fitted with suppressors and cause no radio interference.

Since one end of the shunt field winding was earthed to the generator frame, this connection had to be broken and the end brought out on to an external terminal. The necessity for this is apparent when the circuit diagram (Fig. 2) is studied.

The Control Circuit (Fig. 2)

The basic idea of the layout is that one generator (G 2) supplies a steady voltage whilst the voltage of the other generator (G 1) is varied in sign and magnitude to either buck or boost the steady voltage generated by (G 1).

Say, for example, that (G 2) is adjusted by means of resistance *R* to generate 24 volts. Now if (G 1) is made to generate 24 volts in the same direction by operating the reversing switch (*RS*1) and the resistance (*C*) the voltage across the pair of generators will be 48. If the switch (*RS*1) is now thrown over, the 24 volts generated by (G 1) will oppose that generated by (G 2) and the voltage across the pair of generators will be reduced to zero.

It will be seen that the field current for all generators and motors is taken from generator (G 2) and thus there is a constant voltage available for exciting the fields.

The reversing switch (*RS*2) reverses the direction of the field in the motor (*M*) and thus changes its direction of rotation. Since the field of the motor (*M*) is always at its maximum value, the motor torque is constant for any given armature current whatever the speed.

If a small voltage is applied to the motor armature, which is of low resistance, a large current will flow, giving rise to a large torque and the armature will commence to rotate. As the armature speeds up, so it sets up a voltage opposing the applied voltage. The speed and hence the back voltage will rise till the latter reaches such a value that it only allows sufficient current to flow through the armature to keep it revolving at a steady speed against the torque applied to it. If the applied torque is increased, as, for example, when a cut is commenced on a lathe, the motor speed will drop a small amount, lowering its back voltage and causing an increase in the armature current which will balance the increase in the load.

If the voltage applied to the armature is increased, the load remaining constant, the armature current will temporarily increase causing the motor to accelerate to some new speed such that armature current is reduced almost to its previous value.

Thus to change the speed of the motor it is only necessary to change the resistance (*C*) controlling the field current to the generator (*G*1). To start the motor from rest the voltage across the motor armature is raised from zero to such a value as gives the requisite speed. The sequence of operations to raise the motor to full speed is as follows :—

(1) Resistance (*C*) raised from zero to maximum value ;
(2) Reversing switch *RS*1 thrown over from buck to boost ;
(3) Resistance (*C*) lowered from maximum value to zero.

It was found that with no resistance in the field circuit the " Homelite " generators would produce over 50 volts at 2,200 r.p.m. so in series they will produce over 100 volts.

If used in parallel, each set to a low voltage, 100 amps can be taken from the system for plating work or other purposes requiring a high current at a low voltage.

Ease of connection is ensured by using mains voltage 2 amp. three-pin plugs for the field circuits and 15 amp. plugs for the main armature circuits. No trouble has been experienced with the latter at up to 50 amps.

If it is desired to run another motor off the system it may be simply plugged into the points (3) and (5) and controlled by the existing resistance and reversing switches, the switches (6) and (7), of course, being left open.

The reversing switches (see Figs. 3 and 4) contain a vital resistance (*D*) known as the discharge resistance. If the current flowing in a highly inductive circuit is suddenly interrupted a very high voltage is induced which gives rise to arcing at the switch contacts, if not to a breakdown of the insulation. If, however, before breaking the circuit the inductive members are short-circuited by a suitable resistance, any induced voltage is harmlessly dissipated.

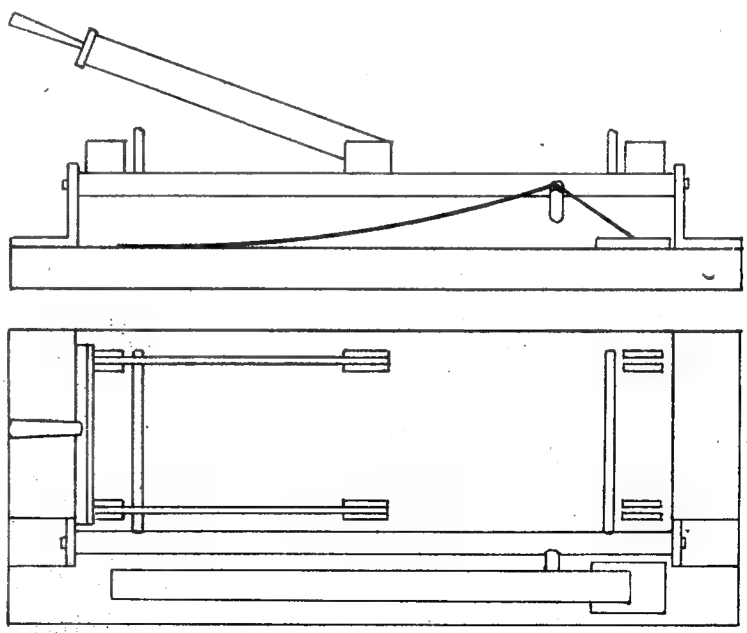


Fig. 4. *The reversing switch*

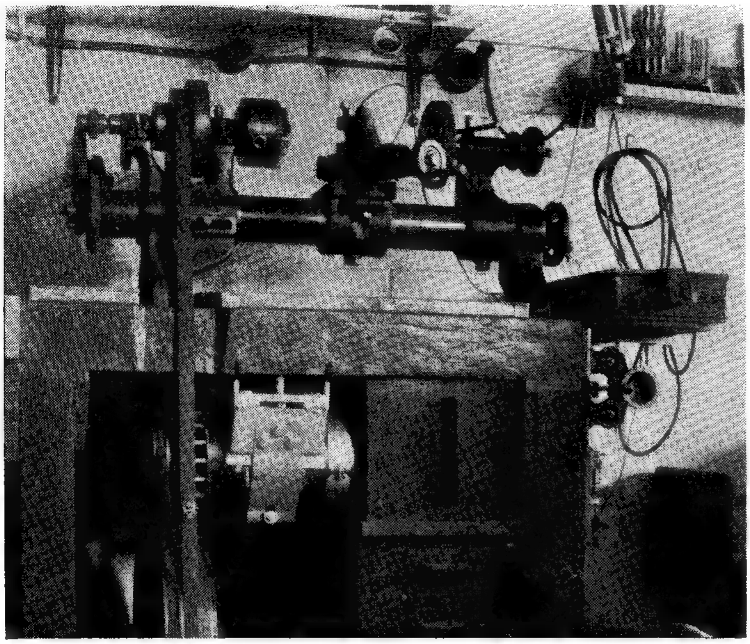


Fig. 5. The Drummond 4-in. lathe connected to a "Homelite" generator

The reversing switches are double-pole knife switches as sold for wireless earth and aerial protection. As will be seen from Fig. 4 a spindle with three arms effects a closing of the discharge resistance circuit before the field current can be interrupted. It is important, of course, that the two arms pressed down by the knives should be covered with an insulating material.

The control resistance (*C*) should properly be of the stud and arm type with graduated resistance elements, but a simple wound slider resistance proves very effective even if the speed response is not proportional to the slider travel.

The £5 Lathe

Fig. (5) shows a Drummond 4 in. lathe driven by a "Homelite" generator of the same specification as those used in the generating set.

Incidentally, this lathe is No. 120 and was originally bought new for £5 and today will still cut a very accurate thread, which shows the value of having the leadscrew in such a well-protected position. On the right leg of the lathe bench can just be seen the handle of the screw-actuated type slider resistance (*C*) and the two reversing switches.

With the lathe belt on the slowest pulley the motor will drive the lathe at any speed from about 30 r.p.m. to several thousand r.p.m., the characteristic being such that the belt is thrown off before the motor can be noticeably slowed from its set speed.

An ammeter (*A*) indicates the load on the motor and soon shows an increased reading if the tool cutting edge becomes dulled.

The voltmeter (*V*) can be calibrated to read in r.p.m. of the lathe mandrel, as its speed is directly proportional to the voltage across the motor armature.

All circuits should be protected by fuses, 2 amp. for the field circuits and 50 amp. for the armature circuits.

Suitable values for the various resistances are :—

(*R*) 0-60 ohms ; (*C*) 0-200 ohms ; (*D*) 40 ohms.

To use the plant for charging accumulators or supplying current for any other purpose, the required voltage is first obtained at (*V*) by adjusting (*RS*1) and (*C*), switches (6) and (7) being left open. The accumulator or other apparatus is then connected to the two outer pins of the plug point (5), and the current adjusted to the desired rate by operating (*C*) again, if necessary.

As the generator set makes a certain amount of noise it can be placed in an unused room, being easily connected by two wandering leads between the plug points (1) and (2), and (4) and (5).

Any number of motors can be driven by the set within its capacity one at a time, or, if required, two at once as when using a toolpost grinder, one being run at constant speed by connecting across the generator G 2 and the other across the pair of generators as described and controlled at will, or both motors may be connected thus and their speeds varied together.

"Support and comfort" for the turner

RECENTLY I was chatting to my friend John in his workshop, when I caught sight of a fresh gadget fixed to his lathe. (He is a real lad for gadgets !) This one consisted of a stout bar (1 in. × ½ in. mild-steel, I should think) projecting about 8 in. from the front of the lathe, and fixed a few inches below the base of the headstock. It was covered with a nicely shaped piece of mahogany, well french-polished, similar in section to a banister rail.

Its purpose was not clear. Something to do with milling or screw-cutting, I thought No, then perhaps a dividing attachment fitted on to it. Hardly; so I asked John. "It's for leaning on," he said, quite casually. "Leaning on ?" I replied, trying to sound suitably horrified. "Yes, why not ?" he answered. "When you are taking a long cut with the self-act, and you have nothing to do for the moment but to watch the chips coming off, don't you find that bending over makes your back ache ? So you rest a hand on the belt guard or headstock, or somewhere else just as dangerous. Well, I've provided a proper place. Yes, it's for leaning on."

Somehow, it all seemed quite wrong for a model engineer to confess he ever *leaned* on anything. Nevertheless, I have become more conscious of my own movements and attitudes while working, and it is curious to note how often that hand seeks a resting place on the lathe. Reluctantly, I am coming round to the opinion that Honest John, with his leaning post, has got something.

I have a suitable length of mild-steel. Now, if only I can find a nice piece of mahogany.—E.M.G.

Inspector Meticulous is not amused !

Tales of a Tyro

By Edward Adams

DRAW-BAR EFFORT AGAIN

INSPECTOR METICULOUS and I have never been on really good terms, and I fear the following tale will further estrange us and truly shock his sense of what is right and proper.

It may be remembered that in my previous notes on draw-bar effort, I promised—or threatened—to apply the "V" treads to *Monstrous*; which is the name I gave to a small but sturdy edition of a New Zealand "K" class of the 4-8-4 type, having several modifications in design from the original to suit my fancy, or it may be from sheer cussedness.

"L.B.S.C." gave particulars of this locomotive in THE MODEL ENGINEER for June 3rd, 1948.

The prototype has a 3 ft. 6 in. rail gauge, which, when scaled down to run on 2½-in. gauge, gives roughly the equivalent of ⅝ in. to 1 ft. scale; a hefty engine for the gauge, hence the name *Monstrous*.

This locomotive has done all that I expected and hoped for in performance, having an abundance of power at the running steam pressure of 70 lb., and a sustained draw-bar pull of 15 lb., using sand on the rails.

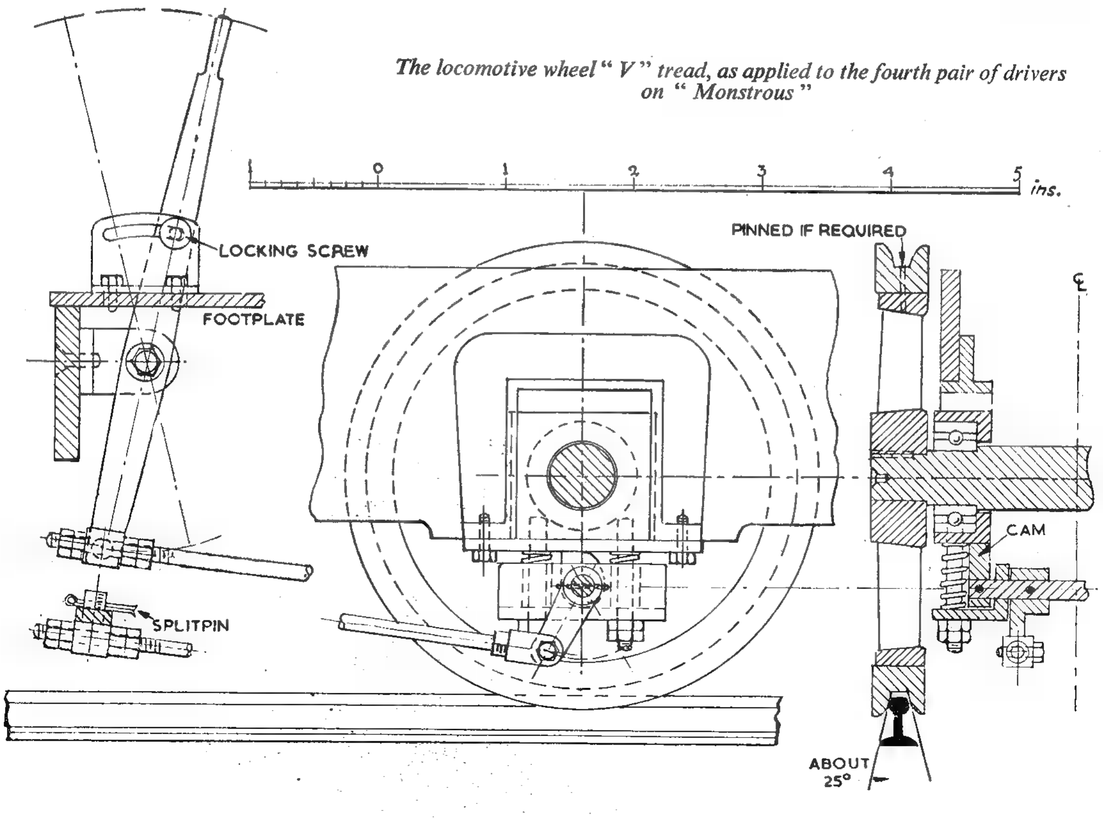
Now I knew that the tractive effort would give a much higher draw-bar pull, if the track adhesion could be increased, so she seemed to me to be a suitable subject for the application of the "V" pulley type of treads, which had given such an improved pull to the *Caterpillar*.

As the fourth pair of driving wheels had no flanges, I decided it would be easy to apply the "V" treads to them; with some misgiving, however, as the original fixed wheel base of 8 in. would become 12 in. and might bind her on the curve.

It seems strange to me now, that this principle—in so far as it has been successful—is the deliberate use of flange friction (which I had hitherto tried to avoid) to increase adhesion.

Also, I realised, that the application of these treads to a pair of wheels would require the rail gauge to be constant; any difference in gauge would, I thought, lead to derailment.

The rails, I discovered, have slight differences in gauge, but as they have some spring, they would, I hoped, give a little to accommodate



The locomotive wheel "V" tread, as applied to the fourth pair of drivers on "Monstrous"

the fixed centres of the "Vs," so I decided to help matters by forming a generous splayed lead-in to the "Vs."

In actual running there does not seem to be any tendency to derail due to the foregoing and she runs freely enough when not under load.

In passing, it seems to me that the use of these "V" treads can have only a limited application; they could not pass through switch points, for instance, or comfortably run where the gauge is varied much, as between curves and straight lengths of track.

So *Monstrous* has been duly shod by turning down the treads of the pair of wheels, and new cast-iron "V" treads made to a good fit and pinned on at three points in the circumference of each wheel.

Also, the wheels themselves have been pinned to the axles to resist the added turning strain imposed on them.

In turning these treads, a short piece of rail was used as a gauge to determine the depth and width of the groove, which must be deep enough to prevent the rail bottoming, as shown on the section.

It will be obvious that the running position of the rail should have the same diameter as the normal wheel treads; rather a tricky result to arrive at.

In the case of the *Caterpillar* the axlebox springs of the wheels so treated, were made stronger than the remainder, in order to increase adhesion; and this answered well enough.

With the *Monstrous,* I am able to vary the adhesion, to some extent, by the use of small cams under the axleboxes, operated from the foot-plate as shown on the drawing.

These will permit the free-play of the springs, or can restrict and even prevent the movement of the boxes, the latter, of course, when the maximum adhesion is required, by increasing the load on this pair of wheels.

Removing a split-pin, releases the rod from the bottom of the foot-plate lever and allows it to drop clear of the pony truck, ashpan and grate, for access to the firebox.

As to results, the boiler pressure being 70 lb., several tests were made on the track, with a spring-balance reading up to 30 lb. between the tender and the first car; the draw-bar pull repeatedly exceeded 30 lb., and finally stretched the spring beyond its "elastic limit."

So we do not know, even now, what the maximum d.b.p. really is.

The tests were made with the cams in the off position, the axlebox springs being operative; no sand was used.

The locomotive itself weighs 78 lb.

On the assumed allowance of 1 lb. d.b.p. for 35 lb. of train, then 30 lb. d.b.p. should start a 1,050 lb. train.

The weight of the tender is	22 lb.
The weight of the double-bogie car	34 lb.
The weight of the four hook-on cars	94 lb.
	150 lb.

This leaves 900 lb. for the weight of the passengers, say, eight to ten, or more, according to age and size, which will about fill our five passenger cars; we may even find it necessary to bring the old original two-bogie truck out of retirement, to tack on the rear for additional accommodation.

Looking at the drawing again, I get the impression that this job, being an adaptation, is but a poor example of engineering; it appears to have a distinct flavour of a Heath Robinson solution; how to produce a small mechanical effort with a considerable amount of contrivance.

There may be other and simpler ways.

It would be interesting to try the effect of the "Vs" applied to all the driving wheels on a locomotive; more logical and better engineering; since the strain on coupling-rods and bearings would be more evenly distributed.

Since writing the foregoing a party of biggish boys came for a running.

After warming up, *Monstrous* moved off easily with six cars and twelve passengers including the driver.

Disguised as an architect

The cams were used only in starting up to prevent wheel-slip.

After about an hour's running she was pulling the whole load at a good speed with no slipping, on 30 lb. steam pressure, and would have pulled more boys and cars, if we had had them.

The total weight of the train and passengers without the locomotive was 1,090 lb.

Well, that's that, and now I suppose my few remaining scale-model friends will desert me, and I may find it prudent to visit the "M.E." Exhibition disguised, for shame, as an architect!

FOR THE BOOKSHELF

Narrow Gauge Rails in Mid-Wales, by J. I. C. Boyd. (South Godstone: The Oakwood Press.) 152 pages, size $5\frac{1}{2}$ in. by $8\frac{1}{2}$ in. Fully illustrated. Price 22s. 6d. net.

It was about 1905 that Wales probably contained more narrow-gauge railways in proportion to its size, than any other country. This was largely due to the extensive quarrying and mining in the mountains, though one or two of the railways owed their existence to the scenic beauties of their respective districts. However, all except two of these small lines have been abandoned and destroyed; but they have found an admirable historian in Mr. J. I. C. Boyd, who, in his previous book, *Narrow Gauge Rails to Portmadoc*, and in this new volume, has set down a fascinating and useful story.

Many of the locomotives illustrated and described would make admirable subjects for large-scale models. Their dimensions are tabulated in this book, and drawings of several of them are included, though to a very small scale. The illustrations cover trains, locomotives, rolling stock and several stations; all are reproduced on twenty-seven art-paper inserts, while maps and plans are printed in the text. It is good to have all this descriptive history put on record before it is too late, and the book is thoroughly deserving of the attention of all who take any interest in railway history.

In the Workshop...

MAKING A DRAUGHTING MACHINE

BY DUPLEX

AS two drawing appliances of the type illustrated have been in use for several years, and have served well for making some hundreds of mechanical drawings, readers who make workshop drawings may be interested in building similar machines ; for the construction is quite straightforward and the necessary materials are easily obtained.

In the first place, it was decided to make the machine of a size suitable for making drawings on quarto paper, measuring 10 in. × 8 in.

This paper is the ordinary size used for typewriting and can be readily obtained in various qualities, most of which will take Indian ink.

The Drawing Board

The appliance can be mounted on an ordinary drawing board, and the most convenient size has been found to be 22 in. long by 13 in. wide ; this allows the quarto paper to be fixed to the board in either the vertical or the horizontal position and to be fully covered by the two rulers.

To make for convenient working, the board is given a slight tilt with the back raised about 1 in. For this purpose, as shown in Fig. 2, two metal cupboard hangers are secured to the back edge of the board near its ends, and a rubber stop of the kind used for supporting lavatory seats is fixed to each hanger by means of a 4-B.A. bolt. In addition to tilting the board, these stops help to steady the board and keep it from slipping on the table.

The Construction

A start can be made with the attachment bracket (*A*), Fig. 3, by means of which the appliance can be either quickly secured to or removed from the board. This part is best made from 3/32-in. sheet brass and, after being cut to shape, it is drilled $\frac{1}{4}$ in. for the pillar-stud and with a No. 27 drill for the three No. 6 wood screws. For making this and some of the remaining parts, the kind of sheet brass used for engraved name-plates will be

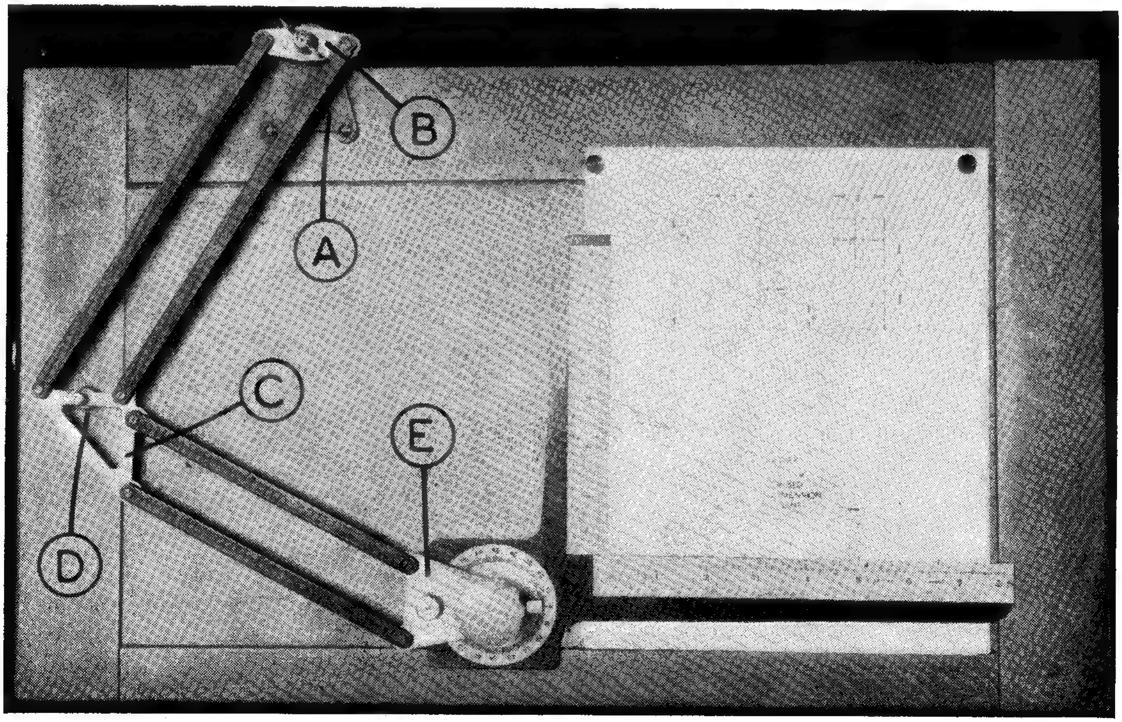


Fig. 1. The finished draughting machine. (A)—the attachment bracket ; (B)—the link bar ; (C)—the fulcrum plate; (D)—the support ; (E)—the head plate

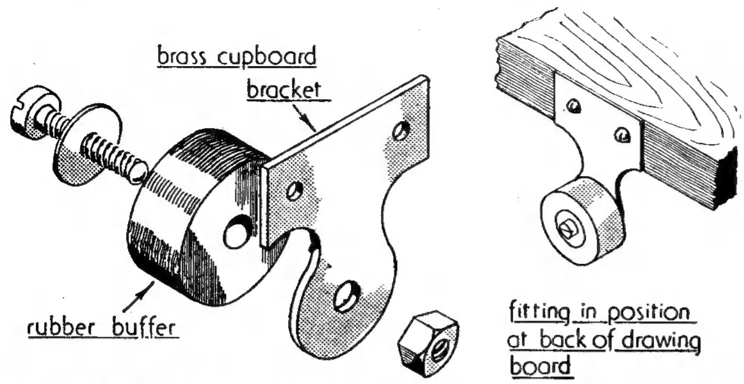


Fig. 2. The brackets for raising the back of the drawing board

suitable, as it is flat and has a good surface finish. After it has been marked out, the material can be cut to shape with a narrow hacksaw blade, such as a piercing or a coping saw, or a round blade with spiral teeth will serve.

The ¼-in. Whitworth collared stud, carrying the arms assembly, is turned from ½ in. dia. brass rod and is secured in the bracket with a nut. A wing-nut is fitted to the upper end of the stud to afford quick removal or clamping of the appliance to its bracket.

The Link Bar (B) and the Upper Arms—Figs. 4 and 5

The bar is also cut to shape from 3/32-in. sheet brass and is drilled centrally to clear the bracket stud. The two holes for the 6 B.A. pivot screws are drilled with a No. 43 drill, but they should not be tapped until a later stage, as this part will be used as a drilling jig. For the two upper connecting-arms, light curtain rod will be found to serve well. This material can be bought in the form of flat steel strip, ⅜ in. wide and 3/32 in. in thickness with rounded edges, and the surface is usually cadmium-plated. As it is essential for the correct working of the machine that the centre distances of the pivots in the two arms should be exactly equal, the two strips should be clamped together with toolmaker's clamps while being drilled at either end with a No. 34 drill. The pivot screws will be fitted and the joints made at a later stage.

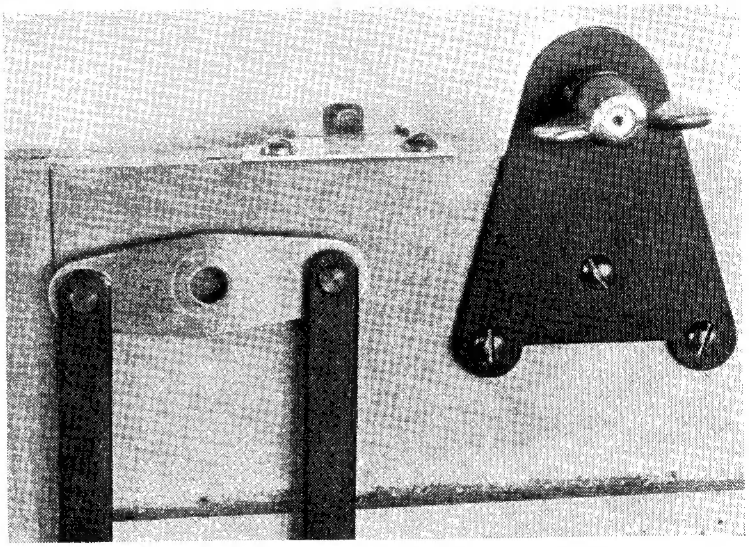
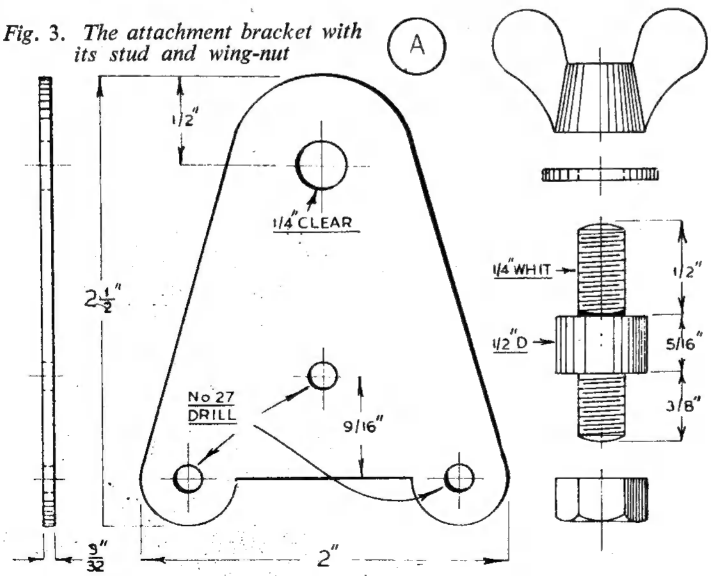


Fig. 4. The attachment bracket and the link bar with the upper connecting-arms

Fig. 3. The attachment bracket with its stud and wing-nut

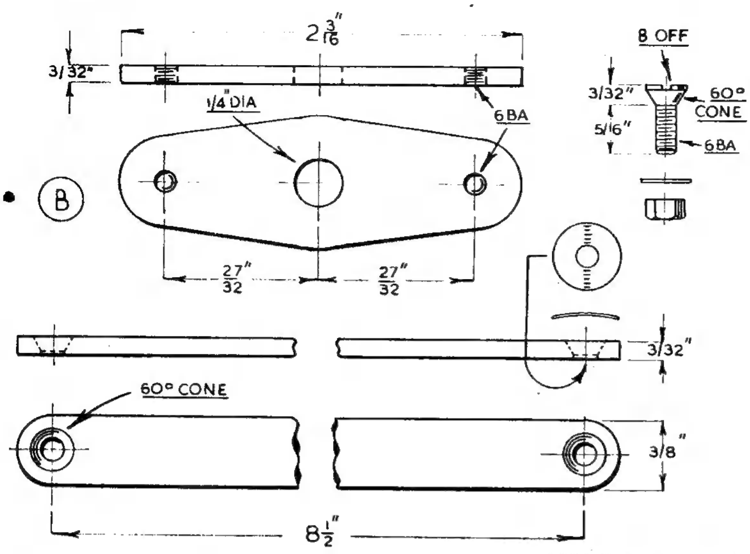


The Fulcrum Plate (C)—Figs 6 and 7

The same brass sheet is used for making this part to carry both the upper and the lower pairs of connecting-arms. The pivot holes for the upper arms are drilled at the correct distance apart by employing the link bar (*B*) as a drilling jig after the two parts have been clamped together.

It is not, of course, essential to cut out the centre of the plate, but this will lighten the part and give a better appearance. When doing this, drill holes can be put through at the three corners and the surplus metal is then cut out with a piercing saw.

The pivot holes for the lower arms are also drilled, but they are left



Above—Fig. 5. The link bar and arms

Right—Fig. 7. The fulcrum plate with its support and the two pairs of arms

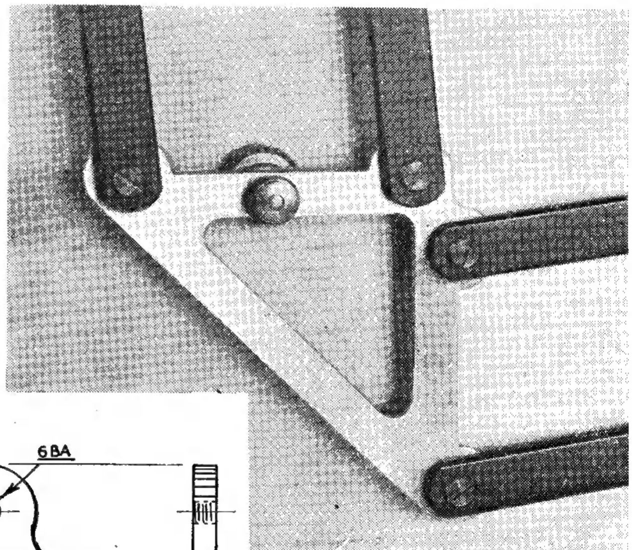
Below—Fig. 6. The fulcrum plate (C) and its support (D)

untapped so that, later, this part can be used as a jig for drilling the pivot holes in the head plate.

The support (*D*) for the fulcrum plate is shown fitted in place in Fig. 7, and its purpose is to maintain the two sets of connecting-arms in horizontal alignment, and so avoid strain on the pivot joints. The felt disc is attached to the central screw with a circular nut and washer, and nuts are fitted both above and below the fulcrum plate so that the height of the support can be correctly adjusted to set the arms level.

The Head Plate (E)—Fig. 8

Cut the plate to shape from the 3/32-in. brass sheet. The holes for the pivot screws are again drilled at the correct distance apart by making use of the fulcrum plate as a drilling jig. The $\frac{1}{4}$-in. dia. hole should be reamed exactly to size,

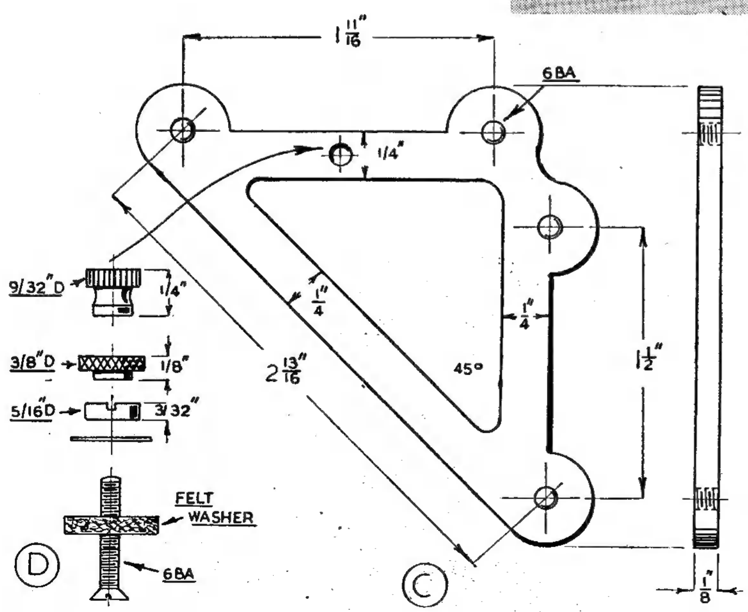


as it forms a bearing for the set-square assembly. The curved slot, in which the clamp-stud of the index plate (*F*) travels, is marked-out from the centre of the $\frac{1}{4}$ in. dia. bearing hole and then filed to shape.

The Index Plate (F)—Fig. 9

The location of the index plate in relation to the head plate, and the position of its clamp screw, will be seen in Fig. 1. After the part has been cut to shape from $\frac{1}{16}$-in. sheet brass, the stud hole is drilled and tapped, and the $\frac{1}{4}$ in. dia. bearing hole is reamed to size.

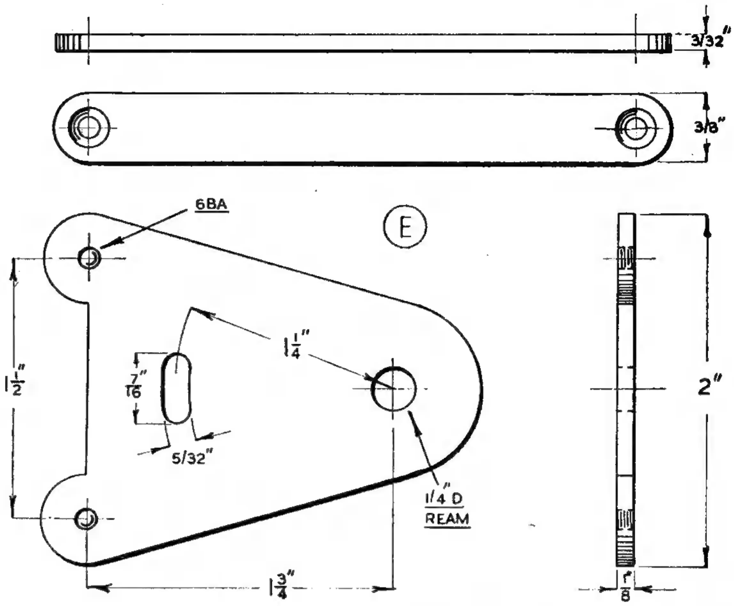
When this part and the head plate are mounted on a $\frac{1}{4}$ in. dia. rod, the stud should be free to travel in the



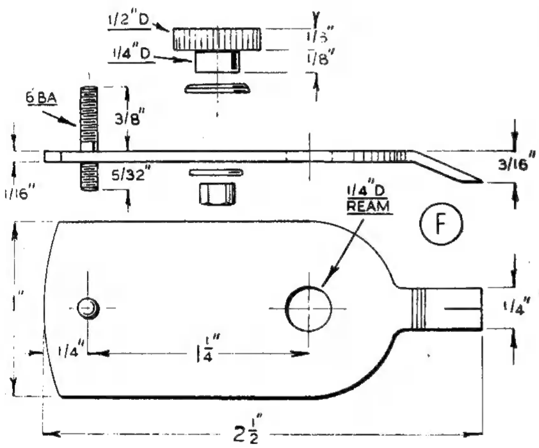
head plate slot, and the two parts will be securely locked together on tightening the clamp-nut. Next, the end of the index plate is bent to project downwards for $\frac{3}{16}$ in. and its upper surface is filed to a good finish. In order to make a neat job of cutting the index line, this line was engraved in the lathe. For this purpose, the plate was mounted by its bearing hole on a threaded stub-mandrel and then secured with a nut. This arbor was then gripped in the self-centring chuck with the bent portion of the plate supported against one of the chuck jaws.

To engrave the index line, the lathe topslide was set over parallel with the bent tip of the index plate, and a V-tool was mounted on its side at centre height in the toolpost.

The centre-line of the tip is now marked-out with the jenny calipers, and the lathe mandrel is locked with the centre-line of the work approximately opposite to the tool point; a final, exact setting is made by rotating the arbor in the chuck jaws.



Above—Fig. 8. The head plate and lower arms



Left—Fig. 9. The index plate and fittings

The index line is then cut to a depth of about 4 thousandths of an inch by traversing the topslide inwards.

Finally, any burrs are removed with a fine file, and the engraved line is filled with a preparation of black wax to make it more easily read. Where it is intended to fill an engraved line in this way, the wax will be retained better if the engraving is done with a tool having an included angle of some 45 deg. at its tip. All this may seem to amount to a lot of unnecessary work for such a small job; but, in the end, it will probably be found the quickest and surest way of cutting an accurate, well-finished line.

It should be noted that the dimensions given are suitable for an index plate designed to read against a protractor of $2\frac{1}{2}$ in. diameter.

(To be concluded)

QUERIES and REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Electric Furnaces

I am proposing to construct a small electric furnace, and I propose to wind the heating element directly on the outside of a small ceramic crucible, with a heavy layer of asbestos outside. Will you please advise me whether this would be satisfactory for melting light alloys, such as brass or bronze, and can you suggest a source of supply of suitable crucibles?

M.E.P. (Marlborough).

An electric furnace made in the manner described would probably have a very high heating efficiency, as it would cut down conduction losses to the minimum, but the disadvantage of making the furnace actually integral with the crucible is that the wear and tear on crucibles is often fairly considerable, and the furnace would then have a comparatively short life.

Ceramic and plumbago crucibles in all sizes can be obtained from Messrs. E. Gray & Sons Ltd., 12, Clerkenwell Road, London, E.C.1.

Small Lathe Construction

I wish to construct a small lathe, approximately 2½ in. centres by 10 in. length capacity. I have occasional access to a large lathe for carrying out the heavy machining. Will you please advise me which of the two types of lathe beds would be most suitable for me: (1) twin 1 in. diameter ground bars, (2) 2 in. × ½ in. rectangular ground bar with a 1 in. × 1 in. stiffener underneath? I have no surface plate or experience of scraping so I should need to purchase accurately ground material. Please advise me also as to (a) the best material for the bed; (b) the best type of headstock bearings; (c) any book which would help me.

L.M.T. (Aberystwyth).

We are of the opinion that the scheme suggested in (1) would be the most satisfactory, as precision ground mild-steel bars are obtainable as a standard stock item, and these could be made the basis of the design.

A lathe built on these principles was described in THE MODEL ENGINEER on May 8th, 1952, and castings and parts are obtainable. The alternative design would involve the necessity of getting bar stock specially ground, and the attachment of the stiffening piece underneath the bar might introduce some difficulties. With reference to your further queries:

(a) The material normally used for lathe beds is cast-iron, but mild-steel working in conjunction with cast-iron bearing surfaces would be satisfactory. The use of mild-steel for both surfaces would be unsatisfactory unless one of them is hardened.

(b) Well-fitted plain bearings are quite satisfactory for small lathes, and if arrangements are made for continuous lubrication, these will work over a very wide range of speed.

(c) Different types of lathe headstock bearings are fully described in the "*M.E.*" *Lathe Manual*, price 12s. 6d., which also gives a great deal of general information of the essential features of lathe design.

American Locomotive History

Can you recommend a good book that gives details of the history of development of American steam locomotives? I am looking for a book that deals with this subject in a similar manner to that of E. L. Ahron's "British Steam Railway Locomotive, 1825-1925."

A.M.B. (Bristol).

We do not believe that there is such a book available now. The only one we have ever seen is Angus Sinclair's *Locomotive Development* published in New York round about 1900. It is strange that in a country like the U.S.A., where the steam locomotive developed steadily and rapidly for more than 100 years, and in a very different form from that generally to be found in other countries, nobody seems to have prepared or published any authoritative work on the lines adopted by locomotive historians elsewhere. A. Sinclair's book is all right up to a point, but it is now more than fifty years out of date, and did not confine itself wholly to American practice.

Model S.E.R. Locomotive

I desire to construct a $1\frac{1}{16}$-in. scale model of a Stirling 4-4-0 locomotive of the old South Eastern Railway. Do you know where I can obtain an accurate drawing for a Class "F" engine showing the original domeless boiler? Would a model of this boiler made to correct scale diameter and length be able to produce enough steam?

S.P. (Kent).

Full working drawings of the S.E.R "F" Class 4-4-0 and tender were published in *The Engineer* about 1890. A ⅜-in. scale side and front elevation drawing of one can be obtained from our Publishing Dept., price 2s. 0d. net.

As to whether a scale-size boiler would produce enough steam, depends on the size of your cylinders and the general arrangement of the boiler. We suggest you adopt 1⅜-in. bore and 2⅛-in. stroke for your cylinders; the boiler could be supplied with twenty $\frac{7}{16}$-in. tubes and worked at 90 lb. pressure. This should give you all the steam you want.

Locomotive Starting Trouble

I have a 3½-in. gauge 4-6-2 locomotive which usually refuses to start when the regulator is first opened; but after I have reversed the engine and opened the regulator and then put her in forward gear again, she gets away quite well. Can you say what is the matter with the engine?

C.M. (Hereford).

This is a trouble that is not unknown in full-size locomotives, and usually occurs when the engine is due for an overhaul. It is probably due to the valve-gear having become out of adjustment through badly worn pins and bushes. You do not say how long your engine has been running since it was built, but, unless your valve-gear, which we assume is of Walschaerts type, was badly made in the first instance, we think your trouble is as we have just stated. The only remedy seems to be rebushing the working parts, if they are already bushed; if they are not, then entirely new valve-gear is wanted.